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VOL. 32. Ser. A. Part 4. pp. 105–144. APRIL, 1944.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 3s. net.

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EVANS (J. W.). **Insect Pests and their Control.**—Roy. 8vo, [4+] 178 pp., 104 figs., 17 refs. [Hobart] Tasmania, 1943. Price 2*s.* 6*d.*

The bulk of this book comprises notes on the bionomics and control of individual pests of importance in Tasmania, arranged according to the food-plants, hosts or material that they infest, which have already been published as articles in the *Tasmanian Journal of Agriculture*. Eight chapters deal with pests of fruit and agricultural crops, and others with those of ornamental plants, forest trees, bees and stored products. A table at the beginning of each chapter indicates the ways in which infestation can be recognised. Chapters on beneficial insects, the biological control of noxious weeds and plant quarantine are also included, and preliminary ones contain short accounts of the life-cycle, structure and classification of insects, which constitute the great majority of the pests, and notes on other Orders of Arthropods, Molluscs and Nematodes, methods of control, the insecticides and fumigants in common use, and the application of dusts and sprays.

KJELLANDER (E.). **Några skadeinsekter på oljeväxter.** [Some Pests of Oil-yielding Plants.]—*Växtskyddsnotiser* 1943 no. 6 pp. 1–6, 8 figs. Stockholm, 1943.

The present increased cultivation of oil-yielding crops in Sweden has provided favourable conditions for certain insects that are not normally of first importance as pests. Rape and white mustard are severely injured, while poppy and flax are but little damaged. Rape is infested by *Ceuthorrhynchus quadridens*, Panz., the larvae of which mine the stalks and petioles and also attack mustard, *Dasyneura brassicae*, Winn., of which the females oviposit in siliquae that have been punctured by other insects [*cf. R.A.E.*, A **31** 322] and the larvae feed on the seeds and siliquae, eventually causing the latter to open, so that the remaining seeds fall to the ground, *Contarinia nasturtii*, Kieff., the larvae of which feed in the flowers, preventing them from opening normally, and *Scaptomyzella flava*, Fall., which has at least two generations a year, mines the leaves in the larval stage and has not previously occurred as a pest in Sweden. Leaf-miners of somewhat less importance are *Ceuthorrhynchus contractus*, Marsh., on white mustard, *Phytomyza atricornis*, Mg., on rape, mustard and poppy, and *P. rufipes*, Mg., which has been bred from rape together with *S. flava*. Little is known of the life-history of any of these insects, but information on the duration of the pupal stage is given for some of them.

[GILYAROV (M. S.).] **Гиляров (М. С.). A short Manual on the Control of the chief Pests of Kok-saghyz.** [*In Russian.*]—Demy 8vo, 39 pp., 21 figs. Ufa, Bashgosizdat, 1943. Price 2 *rub.* 60 *kop.*

The greater part of this handbook consists of notes on the appearance, biology and control of about twenty insect and other pests that attack the rubber-producing plant, *Taraxacum kok-saghyz*, in the Russian Union [*cf. R.A.E.*, A **27** 44, etc.]. Other sections deal with insecticides and mechanical devices that may be used for their control, and with the way in which control should be organised. The various measures required against different pests throughout the season are summarised for European Russia and irrigated regions of Central Asia, and a brief note on the control of pests in the stored seed is included.

KLAGES (K. H. W.). **Ecological Crop Geography.**—Med. 8vo, xviii+615 pp., 108 figs., refs. New York, N.Y., Macmillan Co., 1942. Price $4.50. [Recd. 1944.]

Though this book is not itself concerned with entomology, the second and third of its four parts include matter of interest to workers in any branch of

(475) Wt. P12/3742 1,500 5/44 S.E.R. Ltd. Gp. 432. [A]

ecological study. Part II deals with the general aspects of the physiological environment and is designed to give a perspective of the many and complex interactions of a plant with the factors of its environment. Part III comprises a detailed discussion of the factors and the responses of plants to the various stimuli. As these ecological factors produce not only local but also regional responses, one chapter is devoted to the classification of climates.

THOMPSON (W. R.), Ed. **A Catalogue of the Parasites and Predators of Insect Pests. Section 1. Parasite Host Catalogue. Part 1. Parasites of the Arachnida and Coleoptera.**—ix+151 pp. **Part 2. Parasites of the Dermaptera and Diptera.**—v+99 pp. Imp. 8vo, multigraph. Belleville, Ont., Imp. Parasite Serv., 1943. Price $2 each.

These are two parts of a section of a catalogue of which the main object is to show the Arthropod parasites and predators of any host, the alternative hosts of the parasites and predators, and the geographical distribution of any parasite, predator or host. It is to be published in four sections, *viz.*, parasite host catalogue, parasite catalogue, predator host catalogue and predator catalogue. In the host catalogues, the parasites and predators are grouped under their hosts, assembled under Orders, and the countries from which each has been recorded and the bibliographical references are given. In the other two catalogues, the hosts are to be grouped under their parasites and predators, and the bibliographical references omitted.

Most of the records have been taken from the first 25 volumes of this *Review*, but some obtained from original publications are included.

FREIBERT (A.). **Contribución al conocimiento de la "chinche tintorea" *Dysdercus* sp. (Hemiptera Pyrrhocoridae) con notas sobre su biología.** [A Contribution to the Knowledge of the Cotton Stainer, *Dysdercus* sp., with Notes on its Biology.]—*Bol. Junta nac. Algodón* no. 99–100 pp. 360–370, 9 figs., 6 graphs, 14 refs. Buenos Aires, 1943.

The author describes the injury caused to cotton by *Dysdercus* and states that five species of this genus have been recorded from Argentina, though little is known of their economic importance. They include *D. ruficollis*, L., with which the others have sometimes been confused. Descriptions are given of all stages of an unidentified species of *Dysdercus* that was collected in Salta, Santiago del Estero, Chaco, Formosa, northern Santa Fe and Corrientes, together with an account of laboratory investigations on its bionomics. At an average temperature of 29·2°C. [84·56°F.], the egg stage and total development lasted 4 and 25–41 days, respectively, the corresponding figures at an average of 10·4°C. [50·72°F.] being 12 and 65–135. The adults paired several times, and the females deposited an average of 503 eggs, with a maximum of 833, in about 10 batches, beginning 7–12 days after emergence. The intervals between the batches were usually 1–8 days, but ranged up to 17. The first batches deposited contained more eggs than the later ones. Chromatic variations in the adults were common, and the size of the latter varied with the food-plant. The species was taken on cotton, *Chorisia* sp. and wild Malvaceae.

Labor realizada por la Estación experimental algodonera de La Banda, en el año 1942. [Report of the Cotton Experiment Station of La Banda for the Year 1942.]—*Bol. Junta nac. Algodón* no. 99–100 pp. 371–404, 20 figs. Buenos Aires, 1943.

This report contains a brief section (p. 384) on the pests observed in experimental cotton fields at La Banda, Argentina, in 1942. They include *Epitragus mucidus*, Berg, *Agrotis ypsilon*, Hfn., *Aphis gossypii*, Glov., *Platyedra gossypiella*,

Saund., *Thyreion gelotopoeon*, Dyar, *Tetranychus telarius*, L., *Chalcodermus niger*, Hust., and *Alabama argillacea*, Hb., but the only one that caused serious injury was *Gargaphia torresi*, Costa Lima, against which dusts and sprays of nicotine sulphate were ineffective.

SAUER (H. F. G.). *Horcius nobilellus* (**Berg**) (**Hem. Mir.**) **praga dos algodoais do Estado de S. Paulo.** [*Horcias nobilellus*, a Pest of Cotton Fields in the State of São Paulo.]—*Arq. Inst. biol.* **13** pp. 29–65, 5 pls., 9 figs., 5 refs. São Paulo, 1942. (With a Summary in English.) [Recd. 1944.]

Horcias nobilellus, Berg, a Capsid originally described from Argentina, has caused serious injury to cotton in the northern part of São Paulo [*cf. R.A.E.*, A **28** 9] since 1936 and has also been found in the south of Minas Gerais. A list is given of the other plants, mostly Malvaceae, on which it has been observed in São Paulo, Hambleton's description of the adult [*loc. cit.*] is quoted and the egg and nymph are also briefly described. Females, which represented about 60 per cent. of the adults in the field and the laboratory, lived for about four weeks and males for about three at an average temperature of approximately 25°C. [77°F.]. Pairing, which was observed only at night, occurred 3–6 days, and oviposition began 6–10 days, after emergence. The oviposition period lasted 6–30 days and the number of eggs per female ranged from 15 to 130. The nymphs hatched after 9–20 days, with an average of 11·5, and completed their five instars in about a fortnight. The duration of complete development from egg to adult ranged from 24 to 34 days, and it is estimated that 6–7 overlapping generations are possible during the season.

Natural enemies observed included unidentified parasites, but were scarce and ineffective, spiders being the most important. The character of the soil did not apparently influence the degree of infestation, but delayed planting was followed by increased injury. The cultural control measures recommended are early destruction of the wild food-plants, clean cultivation and early planting in September. Effective control (60–80 per cent.) has been obtained by dusting with sulphur or with mixtures of sulphur and Paris green (4 : 1) or calcium arsenate (2 : 1), applied at the rate of about 12·5–16 lb. per acre at intervals of 8–10 days, beginning when the percentage infestation exceeds 8. Sulphur alone is satisfactory against the nymphs, but the mixtures are more effective against the adults.

AUTUORI (M.). **Contribuição para o conhecimento da saúva** (*Atta* **spp.—Hymenoptera-Formicidae). II. O saúveiro inicial** (*Atta sexdens rubropilosa* **Forel, 1908).** [A Contribution to the Knowledge of *Atta* spp. II. The initial Nest of *A. sexdens rubropilosa*.]—*Arq. Inst. biol.* **13** pp. 67–84, 11 pls., 1 fig., 1 ref. São Paulo, 1942. **III. Excavação de um saúveiro** (*Atta sexdens rubropilosa* **Forel, 1908**).—*T.c.* pp. 137–148, 1 pl., 2 figs., 7 refs. (With Summaries in English.) [Recd. 1944.]

Continuing his investigations on the nests of *Atta sexdens rubropilosa*, Forel, in São Paulo [*cf. R.A.E.*, A **31** 478], the author describes in the first of these two papers the technique by which nests established in the soil were transferred to the laboratory and examined. The queens were allowed to enter the ground on 12th November 1939, and blocks of soil containing them were removed at almost daily intervals thereafter for 72 days. The fungus on which the ants feed was first observed in the nests 2 days after the queens entered the soil, and eggs, larvae, pupae and adults (workers) after 5, 31, 52 and 62 days, respectively. Nests were established in the laboratory in containers built up of hollow bricks and glass plates, further units being added as the nest grew, and descriptions are given of the various activities of the ants as observed through a binocular microscope. Before the fungus produces hyphae, they feed on special eggs deposited by the queen.

In the second paper he gives an account of the contents of a nest examined 47 months after its foundation, just before the second appearance of sexual forms.

MONTE (O.). **Duas novas espécies de** *Diorymerellus* **(Col. Curculionidae), prejudiciais às orquideas.** [Two new Species of *Diorymerellus* injurious to Orchids.]—*Arq. Inst. biol.* **13** pp. 87–90, 1 pl., 7 figs. São Paulo, 1942. (With a Summary in English.) [Recd. 1944.]

The two new weevils described are *Diorymerellus lepagei* and *D. minensis*, from orchids in the States of São Paulo and Minas Gerais, respectively.

AUTUORI (M.). **Dados a respeito de** *Tetrastichus giffardianus* **Silv., parasita da** *Ceratitis capitata* **Wied.** [Data regarding *T. giffardianus*, a Parasite of *C. capitata*.]—*Arq. Inst. biol.* **13** pp. 149–162, 1 pl., 1 fig., 37 refs. São Paulo, 1942. (With a Summary in English.) [Recd. 1944.]

In a review of the literature on *Tetrastichus giffardianus*, Silv., the author points out that it is the only species of its genus that has been introduced into Hawaii against *Ceratitis capitata*, Wied., but was originally misidentified there as *T. giffardi*, Silv. [*cf. R.A.E.*, A **6** 184] and has been erroneously recorded as *T. giffardi* in some of the papers on its introduction from Hawaii into São Paulo, Brazil [**26** 627; **27** 34]. It was bred in the laboratory in São Paulo [*cf.* **29** 344], where its development was completed in 25–35 days. Of 6,607 adults, 3,858 (58·4 per cent.) were females. Pairing occurred immediately after emergence from the host pupa, and the pre-oviposition period varied from 19 to 62 hours. The maximum number of larvae of *C. capitata* parasitised by a single female was 7, and the maximum number of eggs laid 32. Adults kept in glass tubes with honey all survived for 25 days, and the females for up to 35, but those kept without food died in 3 days, even if they had been fed previously. The females preferred to oviposit in the final stages of the host larvae, and 8,797 adults were obtained from 831 host pupae. Temperatures above 20°C. [68°F.] were favourable to the parasite, the optimum for development varying from 25 to 30°C. [77–86°F.]. Up to June 1942, it had been released on 217 properties in São Paulo and consignments had been sent to six other States. It was recovered on five properties in the year of liberation and on two others two years later.

ORLANDO (A.). **Observações dos hábitos de** *Heliothis obsoleta* **(Fabr.) como praga das espigas de milho, e a eliminação dos estilos-estigmas como processo de combate (Lep. Noct.).** [Observations on the Behaviour of *Heliothis armigera*, Hb., as a Pest of Maize Ears and the Removal of the Silks as a Control Measure.]—*Arq. Inst. biol.* **13** pp. 191–207, 4 graphs, 9 refs. São Paulo, 1942. (With a Summary in English.) [Recd. 1944.]

One of the most serious pests of maize in São Paulo is *Heliothis armigera*, Hb. (*obsoleta*, F.), which causes a crop loss of about 7 per cent. The females lay most of their eggs on the silks of the ears, and experiments were therefore carried out in the season of 1941–42 to ascertain the effect on the infestation of the ears of clipping off the silks [*cf. R.A.E.*, A **28** 520; **31** 509]. The maize was planted at the end of December, and the silks were cut 2–3, 5–6, 8–9 or 11–12 days after they appeared. In no case was fertilisation impaired. Early cutting was not always effective, mainly owing to further development of the silks and consequent re-infestation, and the best results were obtained by removing the silks on the 11th–12th days, which reduced the infestation by about 10–40 per cent. It is thought that still later cutting might be more effective.

Young, green silks were preferred by the ovipositing females of *H. armigera* to old, dry ones ; the numbers of eggs were greater in those cut on the 2nd–3rd day and decreased to nearly zero on the 11th–12th day. The eggs of an unidentified fly and of two Microlepidoptera were also present on the silks, together with larvae of *Laphygma frugiperda*, S. & A., and *Diatraea* sp., and adults of *Diabrotica* sp. There was some evidence that clipping increased field infestation of the ears by *Calandra* (*Sitophilus*) *oryzae*, L., and *C.* (*S.*) *granaria*, L.

DE TOLEDO (A. A.). **Notas sobre a biologia da Vespa de Uganda** *Prorops nasuta* **Waterst. (Hym. Bethyl.) no Estado de S. Paulo—Brazil.** [Notes on the Biology of the Uganda Parasite, *P. nasuta*, in the State of São Paulo.]—*Arq. Inst. biol.* **13** pp. 233–260, 4 graphs, 8 refs. São Paulo, 1942. (With a Summary in English.) [Recd. 1944.]

A detailed account is given of observations in 1938–41 on the bionomics of the Bethylid, *Prorops nasuta*, Wtstn., which parasitises the coffee berry borer, *Stephanoderes hampei*, Ferr., and has long been established in São Paulo. The duration of the adult life of females varied with the season and the stage of the host supplied as food. During the hot season it averaged 96·3 days with larvae and pupae as food, and 58·3 with adults, the maximum being 125 and 82 days, respectively. During the cold season it averaged 90·5 days with larvae as food, and 68·5 days with all stages, the maxima being 155 and 124. Unfed females survived for 7–11 days. Males did not appear to feed, and lived for up to 13 days. The ratio of males to females was 1 : 3. Unfertilised females produced only male offspring, but usually paired with them and gave rise to a second brood composed of males and females or females only. Both sexes of a brood remained within the coffee fruit for some days after emergence, and pairing is believed to occur there, as the males were the last to come out of it. Of females taken in nature almost all had paired ; 74·4 per cent. produced progeny of both sexes and 20 per cent. female progeny only.

The pre-oviposition period lasted 8–24 days for fertilised females and 8–39 days for unfertilised ones. As a rule, one egg was laid on each host, but two were occasionally observed. It was usually laid on the ventral region of the thoracic segments of a larva and on the dorso-abdominal region of a pupa. The maximum, minimum and average numbers of eggs deposited per female were 66, 33 and 46 in the hot season and 15, 0 and 7·8 in the cold season. Few eggs were laid during the last 20–25 days of life. The eggs hatched in 2–7 days (2–4 in hot months). At 24°C. [75·2°F.] the larval, prepupal and pupal stages lasted 8, 3 and 9 days, respectively. The larva feeds externally and absorbs the contents of the host in 3–4 days. It then spins a cocoon and enters the prepupal stage. The average and maximum numbers of progeny of females that produced two broods in successive fruits were 16 and 30, or an average of 8 per brood. Counts of cocoons in coffee fruits that were picked in the field and harboured the parasite showed an average of 7 per fruit, indicating that the rate of reproduction is practically the same. Nine generations were observed in the laboratory during the year, the duration of development varying from 29 days at 24·8°C. [76·64°F.] to 66 days at 18°C. [64·4°F.]. The adult remained for up to 3 days in the cocoon after breaking open its end.

The adults flew readily at temperatures above 22°C. [71·6°F.] but not below 20°C. [68°F.]. Having entered an infested fruit, the female remained there until its progeny had reached the adult stage. It killed the adult beetle, used it to close the entrance hole, and itself remained near the sealed orifice, possibly to protect its eggs and larvae. In a recently infested fruit, it fed on the adult beetle and on newly hatched larvae without molesting the other larvae until they reached the age preferred for oviposition. Of the infested fruits in monthly collections, adults but no larvae of *P. nasuta* were present in 0·36 per cent. of those that were green, 1·9 per cent. of those that were mature

and 4·6 per cent. of those that were dry, and adults and larvae were present in 0·05, 0·28 and 1·4 per cent., respectively. Fruits on the bush were preferred to those on the ground. In order to follow the changes in population within fruits, female parasites were allowed to enter infested berries in the laboratory and the latter were examined at intervals. The results are given in a table showing the stages of both host and parasite found and the mortality of the former, from which it appears that no living examples of any stage of the host were present when the adult parasites of the new generation emerged.

The influence of climate upon host and parasite in various districts in São Paulo is discussed. The percentage infestation of the fruits in one locality rose from 2 in January to 30 in May 1940, and the percentage of infested berries that contained parasites from 0·7 to 2·39 in April and 1·35 in May, so that while the percentage of all berries that contained *Stephanoderes* increased during the 5 months to 15 times its initial figure, the percentage that contained parasites increased 29 times. In another locality in which observations were continued from January to June, these percentages were 16 and 80 times as great, respectively, at the end as at the beginning of the period.

BALCH (R. E.) & HAWBOLDT (L. S.). **Report of Forest Insect Conditions in Nova Scotia in 1942.**—*Rep. Dep. Lds For. N.S. 1942* pp. 50–54, 3 pls. Halifax, N.S., 1943.

The numbers of *Gilpinia hercyniae*, Htg., on spruce in the main infested areas in Nova Scotia were even smaller than in 1941 [*cf. R.A.E.*, A **30** 465], and evidence was obtained of the occurrence of larval disease throughout the greater part of the mainland, and of the establishment of introduced parasites. Liberations of parasites during the year comprised a further 160,000 individuals of *Microplectron fuscipenne*, Zett., 1,102 of *Sturmia* sp., 400 of *Exenterus amictorius*, Panz. (*marginatorius*, F.) and 200 of *E. claripennis*, Thoms. *Peronea variana*, Fern., was again present on balsam fir [*Abies balsamea*] though not numerous. *Chermes* (*Adelges*) *piceae*, Ratz., was about as injurious to *A. balsamea* as in the two previous years, and mortality and poor growth of stands in most of the western half of the Province are ascribed to attacks by this Aphid in recent years, particularly about ten years ago. Experimental thinning plots showed about 50 per cent. mortality by volume since 1932, and there was no evidence that thinning had affected the infestation. *Agrilus anxius*, Gory, was found to have attacked the majority of mature stands of yellow birch [*Betula lutea*] in the Cumberland Hills. Mortality in some areas ranged from 2 to 10 per cent. by volume. Analysis of 21 trees showed that this Buprestid was numerous in all those showing dieback, and it is considered that mortality may increase during the next few years. Measures recommended to reduce loss are cutting timber at maturity, the removal of decadent or weak trees, the avoidance of severe thinning, and the felling of birch that has been exposed by cutting other trees. *Pristiphora erichsoni*, Htg., was nowhere numerous on larch, but *Coleophora laricella*, Hb., caused considerable browning of early foliage. Repeated attacks by *C. laricella* in recent years, combined with some defoliation by *P. erichsoni*, have caused considerable twig and some tree mortality. *Pissodes strobi*, Peck, attacked young stands of white pine [*Pinus strobus*]; it does not often infest other trees but was recorded on jack pine [*P. banksiana*] in one locality. An unusual case of infestation of *P. strobus* by *Chermes* (*Pineus*) *pinifoliae*, Fitch, occurred in one county in Nova Scotia and a somewhat similar outbreak was observed in New Brunswick. The latter had probably been in progress since 1939, and had caused extensive browning of new shoots, reduction in wood growth and some mortality. Migration takes place between white pine and red spruce [*Picea rubra*], both of which are common in the infested areas, but it is doubtful whether this is obligatory. On *Picea rubra*, flattening of the needles

on infested shoots results in the formation in early summer of a somewhat loose, cone-like gall. The Aphid does not appear to attack red pine [*Pinus resinosa*] or white spruce [*Picea glauca*]. There was no change in the status of the beech scale, *Cryptococcus fagi*, Baer., in Nova Scotia. Several insects, including *Tortrix* (*Archips*) *fervidana*, Clem., have for some years past caused partial or complete defoliation of oak in early summer in two counties. A list of potentially injurious sawflies and Lepidoptera observed on spruce is appended.

Balch (R. E.). **European Spruce Sawfly in 1942.**—*Rep. Dep. Lds For. N.S. 1942* pp. 90–93, 3 refs. Halifax, N.S., 1943.

The population of *Gilpinia hercyniae*, Htg., on spruce in Canada and the north-eastern United States continued to decline in 1942 [*cf. R.A.E.*, A **30** 464], and except in a few scattered areas, the numbers of larvae and cocoons were moderate or small. It was taken as far west as Minnesota, and in Newfoundland, where there was some increase in the numbers collected in the survey, it had spread eastwards to central districts. In a brief discussion of the various agencies of natural control in Canada, it is pointed out that, as the sawfly reproduces parthenogenetically, it will increase in numbers unless these agencies can prevent the survival of more than about one of the fifty-odd possible offspring of each female. The population increased until about 1938, and then began to decrease, owing to the action of introduced parasites and larval disease. The latter has now replaced some of the other factors, and has been responsible for most of the decline in the last three years. Laboratory studies on the disease were continued in 1942 [*cf.* **30** 465] ; although the causal agent did not pass through filters, other evidence suggests that it is a virus and that the associated bacteria [*cf. loc. cit.*] are secondary. It infects larvae that ingest it by feeding on infected foliage and can apparently spread in the air from larval remains and excreta. The disease has been successfully established in Ontario by means of a water extract of infected larvae. A similar disease occurs in Europe, and it may have been brought to America in the course of parasite introductions.

Further field studies on parasites by W. A. Reeks showed that the disease has interfered with their normal reproduction by reducing the host population [*cf. loc. cit.*] and in the case of *Exenterus* spp. by killing many of the larvae on which eggs had been laid. Both *Microplectron* [*fuscipenne*, Zett.] and *Exenterus* are maintaining themselves, however, and the distribution of the latter is widening in the Gaspé peninsula.

Burks (B. D.). **The North American parasitic Wasps of the Genus *Tetrastichus* —a Contribution to Biological Control of Insect Pests.**—*Proc. U.S. nat. Mus.* **93** no. 3170 pp. 505–608, 6 figs., 19 refs. Washington, D.C., 1943.

In this revision, *Epitetrastichus*, Gir., and *Neomphaloidella*, Gir., are among the genera not considered distinct from *Tetrastichus*. Specific synonyms include *T. thripophonus*, Wtstn. (*tatei*, Doz.) and *T. minutus*, How. (*blepyri*, Ashm., *detrimentosus*, Gah.). *T. gibboni*, Gir., is transferred from *Ootetrastichus*, and *T. whitmani*, Gir., from *Aprostocetus*.

Among the new species described are *T. melanis* reared from predacious Coccinellids ; *T. pandora* from eggs of *Coloradia pandora*, Blake, on *Pinus ponderosa* ; *T. triozae* from nymphs of *Paratrioza cockerelli*, Šulc, and (?) *Calophya nigripennis*, Ril. ; *T. scriptus* from a primary parasite (*Euplectrus* sp. ?) of *Melasoma lineatopunctata*, Forst. (*Lina scripta*, F.) ; *T. cassidis* from larvae of *Chirida signifera*, Hbst., and *Metriona bicolor*, F. ; *T. carpatus* from *Apanteles carpatus*, Say, and (also probably as a parasite of this Braconid) from *Tineola biselliella*, Humm., *Tinea pellionella*, L., and *T. fuscipunctella*, Haw. ; *Tetrastichus faustus* from the cherry maggot, *Rhagoletis fausta*, O.-S. ; and *T. malophilus* from the apple leaf weevil, *Rhynchaenus* (*Orchestes*) *pallicornis*, Say. All are from the United States and *T. melanis* also from Ontario.

Service and Regulatory Announcements, July–September 1943.—*S.R.A., B.E.P.Q.* no. 156 pp. 25–34. Washington, D.C., U.S. Dep. Agric., 1943.

In view of the wide variation, due to climatic and seasonal conditions, of the effectiveness of the various materials and treatments in use against the Japanese beetle [*Popillia japonica*, Newm.] in the United States, and the desirability of employing new methods as soon as they become available, Administrative Instructions (B.E.P.Q. 529, superseding B.E.P.Q. 499 and its supplements) relating to Quarantine no. 48 against *P. japonica* permit the use, under the supervision of an inspector, of such treatments before they have been formally authorised. Inspectors will be currently instructed on the treatments and their ranges of applicability. Lists are given of the various materials at present authorised for the treatment, in accordance with instructions issued to inspectors, of fruits and vegetables and of friable soil in the absence of plants and about the roots of plants before and after digging.

Announcements relating to potato regulations in the United States contain Amendment no. 5 to regulation no. 7 [*cf. R.A.E.*, A **11** 172; **32** 21] authorising the importation under specified conditions of potatoes from the States of Chiapas, Jalisco, Queretaro, San Luis Potosi and Sonora, Mexico, since surveys indicate that *Epicaerus cognatus*, Sharp, does not occur in them.

Sleesman (J. P.) & Wilson (J. D.). **Comparison of Fixed Coppers and Bordeaux Mixture in the Control of Insects and Diseases on muck-grown Irish Cobbler Potatoes.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* **28** no. 223 pp. 173–183, 29 refs. Wooster, Ohio, 1943.

An account is given of experiments carried out in Ohio in 1934–42 on the combined control of *Empoasca fabae*, Harr., *Epitrix cucumeris*, Harr., and fungous diseases on potato chiefly by means of Bordeaux mixture (the standard treatment for this purpose), fixed copper compounds and sulphur. The sprays or dusts were applied at intervals of 10 days beginning when the plants attained a height of 6 ins. Populations of the leafhopper were estimated by counting the nymphs on 10 leaves and of the flea-beetle by counting the adult feeding punctures in unit areas on 20 leaves. Foliage protection was assessed by estimating the percentage of dead foliage; hopperburn represented the most serious injury to the foliage, but fungous disease was a contributory factor in two years. The yield was reduced by both insects in each year. When copper compounds were compared, the formulae used provided for approximately equal contents of metallic copper. The results for each year are shown in tables and are discussed.

For the whole period the average yield of plots sprayed with Bordeaux mixture was 421 bushels per acre and that of unsprayed plots 313 bushels. Changes in the ratio of copper sulphate to lime in the mixture made no significant difference to the degree of control of *Empoasca fabae* and fungous disease or to the yield, though there was in some cases a tendency for a lower proportion of lime to result in a higher yield [*cf. R.A.E.*, A **28** 92]. Variation of the amount of copper sulphate from 4 to 20 lb. per 100 U.S. gals., so that the greater part of the sulphate was applied early or late in the season, did not give appreciably better control or yield than those obtained by uniform treatment [*cf. loc. cit.*]. The addition of calcium arsenate to Bordeaux mixture and to a dust containing copper oxychloride-sulphate had no significant effect on yield. The addition of a spreading agent to Bordeaux mixture was of no benefit; but spraying the foliage again as soon as it had dried resulted in a higher yield in the season in which it was tested than single spraying.

Yields comparable with those given by Bordeaux mixture were obtained by dusting with copper sulphate and lime (20 : 80) while the plants were wet with dew and by dusting and spraying with various proprietary fixed copper compounds. Basic copper arsenate, used as a spray, afforded poor foliage protection

and low yield. Spraying with 15 and 20 lb. lime per 100 U.S. gals. water and with a fixed nicotine resulted in a low degree of leaf-hopper control, low yields and no foliage protection. In 1941, dusts of copper oxychloride-sulphate with bentonite as an adhesive and talc or pyrophyllite (Pyrax ABB) as a diluent resulted in excellent yield, leafhopper control and foliage protection. In general, the fixed copper compounds appeared to be more effective as dusts than as sprays, and the chlorides controlled the leafhopper and improved yield to a greater extent than a basic sulphate and an oxide. Dusts of sulphur and lime (90 : 10 and 80 : 20) were of value in controlling the leafhopper but the yields were lower than those obtained with Bordeaux mixture in 5 of 6 years and foliage protection was poor. Since the leafhopper populations were low and fungous disease generally absent, it is thought that sulphur may be injurious to the foliage, and a reduction in foliage protection when sulphur was added to Bordeaux mixture and to copper-lime dust supported this view. The addition of derris or pyrethrum to dusts of copper oxychloride-sulphate or sulphur had little or no effect on leafhopper populations or yield.

Data on the control of the flea-beetle are shown for 1939–42 only. In each of these years, control was not improved by adding calcium arsenate to Bordeaux mixture, and in 1942 dusts of copper oxychloride-sulphate with derris or pyrethrum were slightly inferior to Bordeaux mixture alone.

MACKIE (D. B.) & others. **Bureau of Entomology and Plant Quarantine.**—*Bull. Dep. Agric. Calif.* **31** (1942) no. 4 pp. 163–198. Sacramento, Calif., 1943.

Attempts to eradicate the citrus whitefly [*Dialeurodes citri*, Ril. & How.], *Melanaspis obscura*, Comst., and *Nilotaspis halli*, Green, were continued in California in 1942 [*cf. R.A.E.*, A **30** 602]. *D. citri* was found at only two places, in February and June, respectively ; treatments were applied at both, and all subsequent inspections gave negative results. The pecan trees infested with *M. obscura* that were fumigated with hydrocyanic acid gas in 1941 [*loc. cit.*] were again fumigated, using a dosage of 35 cc. per 100 cu. ft., on 19th February. No living Coccids were found on them in subsequent examinations ; no dead Coccids were present on the two-year-old wood, but some were found on the three-year-old wood of one tree, indicating that it had been infested before the first fumigation. Two new infestations of *N. halli*, one originating from fruit trees introduced 15 years before, were reported during the year. Improved equipment, comprising a disk of coarse carborundum cloth rotated at 3,500 revolutions per minute, was used for removing the heavy accretions of bark prior to spraying [*loc. cit.*], but microscopic examination showed that young Coccids that entered cracks in the bark were still protected. Two applications of summer oil were made, in early May and late July, and were to be followed by winter spraying. The olive scale, *Parlatoria oleae*, Colv., is now known to be established in six counties, and an attempt was made to eradicate small widely separated infestations, particularly those near large numbers of the preferred native food-plants, such as *Ceanothus* and manzanita [*Arctostaphylos*]. Good control was given by dusting olive trees with calcium cyanide or fumigating them under tents with calcium cyanide or liquid hydrocyanic acid, and by fumigating nursery stock with hydrocyanic acid or methyl bromide, individuals at the second moult being the most resistant to hydrocyanic acid.

In co-operative investigations on cherry fruit-flies, the United States Bureau of Entomology, the Oregon State College and the California Department of Agriculture have made extensive surveys in California and assembled large collections of adults of *Rhagoletis cingulata*, Lw., and the form that infests *Prunus emarginata* and had been classified as *R. indifferens*, Curr. [*cf.* **31** 511, etc.]. As a result, the specialists of the Bureau have decided that *R. indifferens* is synonymous with *R. cingulata*, as the characters proposed to differentiate it

are not constant. Surveys of the distribution of *R. cingulata* and of *R. fausta*, O.-S. [*cf.* **29** 565 ; **30** 307] in Washington, Oregon and California indicate that these species appear to have the same range and are confined to that part of the Pacific States designated as the transitional life zone where the natural food-plant is *Prunus emarginata*. Cultivated cherries are attacked if they are close to *P. emarginata* and have reached the susceptible stage of development when the adults emerge. *R. fausta* emerges from hibernation earlier than *R. cingulata*, and the availability of cherries varies with latitude and altitude.

Larvae of *Cydia* (*Grapholitha*) *molesta*, Busck, were found on peach over an area about 20 miles in diameter in Orange County during the late autumn of 1942, and adults were taken in the following spring. The moth had not previously been established in California.

The area infested by *Anabrus simplex*, Hald., covered 15 sq. miles in 1942, and some damage to hay crops occurred in one district. Surveys indicated that eggs were deposited over an area of 800 acres, but this Tettigoniid is apparently unable to exist in injurious numbers west of the Sierra Nevada mountains. *Gryllulus* (*Gryllus*) *assimilis*, F., caused some damage to cotton seed and lint in the San Joaquin Valley and to tomatos in the Sacramento Valley, and migrating swarms constituted a nuisance in towns in the Imperial Valley. Damage to lucerne by the alfalfa butterfly [*Colias eurytheme*, Boisd.] ranged up to 50 per cent. of the crop in some fields. Cutworms, especially the variegated cutworm [*Peridroma saucia*, Hb.], caused losses to a wide variety of crops. Surveys of the green peach Aphid [*Myzus persicae*, Sulz.] made in the Tule Lake area in view of its ability to transmit virus diseases of potato showed that it was common on *Solanum villosum*, though populations were not large. *Phyllocoptes destructor*, Keifer, spread into the important tomato-growing areas in the north-central part of the State ; a dust containing 25 per cent. sulphur was effective when applied before the mites became injurious [*cf.* **30** 363]. *Harrisina brillians*, B. & McD., which skeletonises the leaves of grape vines and appears periodically along the Mexican border, particularly in Arizona, where it is controlled by arsenicals, occurred in numbers in one county ; it attacked the native *Vitis californica*, Virginia creeper [*Parthenocissus quinquefolia*] and Boston ivy [*P. tricuspidata*] and spread to cultivated vines in some places. *Desmia funeralis*, Hb., continued to damage vines in central districts [**30** 603] ; *Bracon* (*Microbracon*) *cushmani*, Mues., parasitised many of the larvae in autumn, but did not afford much control.

Miscellaneous pests identified during the year included *Toumeyella liriodendri*, Gmel., which was recorded, for the first time in California, on tulip tree [*Liriodendron*] and *Magnolia* ; *Chrysomphalus dictyospermi*, Morg., which occurred on lemon growing out of doors in one district of Ventura county, the only part of California in which *Citrus* is infested by it ; *Matsucoccus bisetosus*, Morrison, on Monterey pine [*Pinus radiata*] ; and *M. fasciculensis*, Herbert, on Jeffrey pine [*P. jeffreyi*].

In experiments on fumigation of nursery stock with methyl bromide, complete mortality of the vine phylloxera [*Phylloxera vitifoliae*, Fitch] without injury to the plant was given by exposure to a dosage of 2½ lb. per 1,000 cu. ft. for 2 hours at 80°F. and of 2 lb. for 3 hours at 60 and 70°F. [*cf.* also **31** 510], and these schedules (at 70°F. in the case of the second) were effective against four species of Coccids on *Camellia*. *Citrus* seedlings with bare roots were uninjured when fumigated with their roots in water, wrapped in sphagnum moss, or covered with soil, though grapefruit seedlings with the roots covered with soil wilted temporarily. Nursery pear trees were successfully fumigated by covering them with rubberised tarpaulin and allowing them to be warmed by the sun to a suitable temperature before the fumigant was released.

Lists of injurious insects intercepted at maritime ports, at border inspection stations and within the State or found in nurseries, and notes on revision of quarantine regulations are included.

Quayle (H. J.). **The Increase in Resistance in Insects to Insecticides.**—*J. econ. Ent.* **36** no. 4 pp. 493–500, 36 refs. Menasha, Wis., 1943.

This discussion of field and laboratory evidence indicating increased resistance to insecticides in certain insect pests and the method by which resistance is inherited is based chiefly on the literature. The insects in which increased resistance has been proved [*R.A.E.*, A **27** 342, 343; **31** 411; B **30** 164] belong to four Orders of widely different food habits, and show an increase in resistance to insecticides representing contact and stomach poison sprays, fumigants, bait sprays and insecticides incorporated in the medium in which the insect lives. It is also pointed out that circumstantial evidence in California suggests that *Paratetranychus citri*, McG., on *Citrus* has become more resistant to sulphur dust and lime-sulphur sprays, *Rhagoletis suavis* var. *completa*, Cress., on walnuts to cryolite, and *Taeniothrips simplex*, Morison, on gladiolus, to sprays of tartar emetic and sucrose. Moreover it appears that Selocide (potassium ammonium selenosulphide) has ceased to be effective against *Tetranychus telarius*, L., in greenhouses in the eastern States, though it was of outstanding value for a few years.

Baten (W. D.) & Hutson (R.). **Precautions necessary in estimating Populations of small Animals.**—*J. econ. Ent.* **36** no. 4 pp. 501–504, 3 figs. Menasha, Wis., 1943.

The author describes a technique used in Michigan in 1941 to estimate the numbers of *Paratetranychus pilosus*, C. & F., on apple leaves before and after spraying with 1 per cent. rotenone in mannitan monolaurate (1 pint per 100 gals.), with the precautions that were found to be necessary, since it is considered that similar difficulties will be encountered in estimating the population of any small animal. A cardboard frame concealing all but 1 sq. in. of the upper and lower surface was placed on the leaves at random and the numbers of mites on these areas were counted by means of a reading glass. It was found necessary for the persons making the counts to practise for several hours in order to avoid errors due to clustering mites, their habit of hiding in inequalities of the leaves, their increased activity on sunny days, the presence of foreign particles on the leaves, and bias in taking sample leaves. Owing to variations in the numbers of mites in different parts of the tree, it was necessary to pick leaves at random from the tips of twigs, near the trunk and from the central regions of the branches near the top, middle and lower parts of the tree. Analysis of the results indicated that the population on samples of less than 200 leaves differed significantly from the average accepted for the tree, and it is considered advisable to use 300, as it is difficult to take a random sample from a large tree. The average number of mites was significantly higher on the lower than on the upper surface of the leaves.

Counts made on 29th July, three days after spraying, on 2nd August, and then at weekly intervals showed that the spray was effective, but did not eradicate the mites, leaving an average population of about three per leaf; the percentage kill did not reach its maximum until 9th August. On 19th September, the number of mites had increased, showing that eggs were again hatching. It is pointed out that it is important to spray immediately after a good estimate of the mite population has been made from an adequate random sample, and to make counts as soon as possible after spraying.

Harries (F. H.). **Some Effects of alternating Temperatures and Exposure to Cold on embryonic Development of the Beet Leafhopper.**—*J. econ. Ent.* **36** no. 4 pp. 505–509, 1 fig., 13 refs. Menasha, Wis., 1943.

As many studies have shown that insects develop more rapidly under varying temperatures than would be expected from the relative effects of constant

temperatures, and it had been found in unpublished experiments that the percentage acceleration of development of *Eutettix tenellus*, Baker, varied with the temperatures involved and also with the time of exposure to different temperatures, tests were made in Idaho to determine these relations more clearly in work on the egg stage. Eggs deposited on small sugar-beet plants by overwintered females from outdoor cages and exposed to 90°F. for periods of 4, 8, 12, 16 or 20 hours, alternating with exposure to 80, 70, 60, 50 or 40°F. for the remainder of each 24-hour period, at a relative humidity of approximately 50 per cent., all hatched in less time than would be expected from that required at constant temperatures. In most cases there was a progressive increase in acceleration of development with successively shorter daily exposures at the higher temperature, and, with the exception of the series exposed to 40°, which is well below the threshold of development, the percentage acceleration increased with the difference in temperature. It is considered that since the daily period of higher temperatures tends to shorten with increase in the daily range of temperature occurring in spring and autumn, both factors of temperature and time of exposure would apparently act to the advantage of the species in permitting more development than would otherwise occur in the cooler seasons of the year.

The effect of cold periods in March and April, which often suspend or greatly reduce development of the eggs deposited early in spring, and their relation to the influence of similar minima in daily temperature fluctuations was studied by keeping eggs in early stages of development at 40 and 50°F. for 2–15 days and then allowing them to develop at 90°F. The results showed only slight or random deviations for shorter periods at the lower temperatures, but significant acceleration in development at the higher temperature after exposure to 50°F. and definite retardation after exposure to 40°.

STONE (M. W.). **The Effect of Winter Soil Temperatures on Emergence of Adults of the Sugar-beet Wireworm in Cages.**—*J. econ. Ent.* **36** no. 4 pp. 510–515, 2 figs., 1 ref. Menasha, Wis., 1943.

The following is based on the author's introduction and summary. Cage experiments were carried out in California in 1931–42 to determine the effect of soil temperatures on the time of adult emergence of *Limonius californicus*, Mannh., knowledge of which is important, since the reduction of wireworm populations by cultural or chemical practices can be most effectively accomplished by proper timing. It was found that in sandy-loam soils, temperature was the chief factor affecting the beginning of emergence, soil temperature at a depth of four inches during September–January being an indicator of the time of appearance of the adults [*cf. R.A.E.*, A **30** 116]. When temperatures during this period averaged 65–67·2, 62–63·5, about 60 and below 60°F., emergence began on or before 24th January, between 30th January and 15th February, after 15th February, and in March, respectively. Daily temperatures during the previous week or on the day of emergence are apparently not so important as those earlier in the season. In one year, emergence occurred when the temperature at a depth of four inches reached a maximum of 58°, as compared with 66, 69 and 70° in other years. Neither a deficiency nor an excess of soil moisture appeared to affect the initial appearance of the beetles, as emergence began on or about the same date when extremes of these conditions prevailed.

Although peaks of male emergence were recorded in each of the weeks 20th February–26th March, the greatest number of males emerged during the week ending 5th March. The seasonal peak of the females was reached during 13th–19th March in six years and during the week ending 12th March in four years. Males were always more numerous during the first two weeks and in some years during the third–sixth weeks of the emergence period, whereas females

were predominant during the remaining weeks. The latest date of male emergence was 7th April and the last female emerged on 12th April. Males emerged over a period of 24–72 days, females over 31–71 days and both over an average of 52 days.

Bibby (F. F.) & Secrest (J. P.). **Sodium Fluoride as an Ant Control.**—*J. econ. Ent.* **36** no. 4 p. 515. Menasha, Wis., 1943.

It is reported that a single application of sodium fluoride to the surface of many nests of various ants and slightly within them, by means of a small bellows duster, gave complete control in every case, usually within 1–2 days, at Pensacola, Florida, in May and June 1943. The ants in question comprised *Pogonomyrmex badius*, Latr., *Soleñopsis geminata*, F., *Dorymyrmex pyramicus*, Roger, *D. flavus*, McCook, *Pheidole dentata*, Mayr, and *Paratrechina longicornis*, Latr.

Busbey (R. L.), Howard (L. B.) & Fulton (R. A.). **Adherence and Retention of Sulfur on *Citrus* Foliage.**—*J. econ. Ent.* **36** no. 4 pp. 516–519, 2 figs., 4 refs. Menasha, Wis., 1943.

Investigations are described on the amount of sulphur deposited by regular commercial dustings and the retention of the material between dustings, carried out in southern California in 1938–41 in orange and lemon groves that were being treated for the control of *Scirtothrips citri*, Moult. No difference was found in the rate of weathering in groves showing marked differences in temperature, humidity and wind, or in the amount of sulphur deposited at the top or bottom of the tree, but there was considerable variation in the deposits on individual trees. Initial deposits ranged from 41 to 125 micrograms per sq. cm., depending on weather conditions at the time of dusting, and subsequent applications also showed a wide variation of deposits. The deposits persisted well in the dry weather normally encountered in southern California during the dusting season, but were almost completely removed by heavy rain.

Henderson (C. F.). **Concentration of HCN and Mortality of *Cryptolaemus montrouzieri* in the Foliage of a fumigated Tree and on the Ground beneath.**—*J. econ. Ent.* **36** no. 4 pp. 519–524, 3 figs., 3 refs. Menasha, Wis., 1943.

An account is given of investigations in 1940–42 to determine whether there was any difference between the mortality of adults of *Cryptolaemus montrouzieri*, Muls., in the foliage of *Citrus* trees and on the ground underneath after fumigation with concentrations of hydrocyanic acid gas normally used in the United States for the control of *Aonidiella aurantii*, Mask. Preliminary tests having shown no significant differences in mortality between insects reared in the insectary and those collected in the field or between beetles inside and outside the cages used in the experiments, and that in field fumigation, even with low dosages, most of the beetles would soon be stupefied and would spend most of the exposure period on the ground, insectary-reared adults were caged among the foliage of orange and lemon trees and on the ground underneath and subjected to fumigation with HCN at the rate of 16–24 cc. per 100 cu. ft. Approximately 90 per cent. of all the beetles were killed. When the HCN was vaporised before application or applied by the pot method, gas concentration throughout most of the exposure period and mortality were both rather higher in the tree than on the ground, though the difference in mortality usually did not reach significance. When liquid HCN was atomised into the fumigation tent, however, concentrations were very much higher on the ground than in the tree during the first part of the exposure, and mortality was significantly greater on the ground. No apparent difference in mortality was caused by differences in soil moisture.

At lower dosages (approximately 11 cc. per 100 cu. ft.) vaporised HCN caused higher mortalities in the trees than on the ground, but combination of all the results obtained showed that at commercial dosages no appreciable differences in mortality would result whether the beetles remained in the tree or dropped to the ground during exposure to the gas.

COLLINS (D. L.) & NARDY (R. V.). **Bordeaux and other Sprays for Control of Japanese Beetle.**—*J. econ. Ent.* **36** no. 4 pp. 525–531, 2 figs., 7 refs. Menasha, Wis., 1943.

A spray of Bordeaux mixture containing 8 lb. copper sulphate and 8 lb. lime per 100 U.S. gals. with the addition of 6 lb. lead arsenate having satisfactorily protected several thousand young elm trees and seedlings from adults of *Popillia japonica*, Newm., in New York, this spray was compared with others composed of materials commonly used by fruit-growers and nurserymen, commercial products advertised as Japanese-beetle sprays and chemicals submitted by their manufacturers for trial. In field tests on elm trees five years old and up to 12 ft. in height, those sprayed with the Bordeaux mixture and lead arsenate, Bordeaux mixture alone or 6 lb. lead arsenate and 4 lb. wheat flour per 100 U.S. gals. water had least beetles three days later, but at the peak of attack, those treated with Bordeaux mixture and lead arsenate had by far the least, the other two sprays named and two proprietary sprays being next in efficiency. Leaf injury by the beetles was least on trees treated with the two lead-arsenate sprays and one proprietary spray. Sprays containing aluminium sulphate and lime, derris powder with a spreader-adhesive, fixed nicotine (nicotine sulphate and bentonite) or copper cyanamide and linseed oil were less effective.

Of potted three- to four-year-old trees about 5 ft. high, to which beetles were attracted by means of bait in containers from traps, those treated with Bordeaux mixture and lead arsenate had the smallest beetle populations, and least foliage injury. Sprays of Bordeaux mixture alone, derris with spreader, ferric dimethyldithiocarbamate and bentonite, or lead arsenate with a spreader-adhesive were less effective, and trees treated with phenothiazine had more beetles than the control trees.

In further tests, twigs from sprayed bushes of bayberry (*Myrica carolinensis*) were hung in a plot with bait containers at intervals to attract the beetles. Foliage injury by them was significantly lower on twigs treated with Bordeaux mixture or with 2 lb. ferric dimethyldithiocarbamate or phenothiazine and 2 lb. bentonite per 100 U.S. gals. water than on untreated ones. Aluminium sulphate with lime was ineffective. Bordeaux mixture with lead arsenate was not tested in this experiment.

It is concluded that Bordeaux mixture with lead arsenate is the best of the sprays tested. The number of applications necessary in a given season depends on the amount of rainfall and consequent weathering of the residue ; one gave good protection for more than three weeks in 1941. Bordeaux mixture alone was effective, but did not leave such a heavy or durable residue, and phenothiazine or ferric dimethyldithiocarbamate with bentonite compared favourably with it in several tests.

GINSBURG (J. M.). **Basic Lead Arsenate : its Effect on Peach Trees and Compatibility with various Chemicals.**—*J. econ. Ent.* **36** no. 4 pp. 531–535, 24 refs. Menasha, Wis., 1943.

As the seasonal occurrence of injury to peach by acid lead arsenate in sprays is a serious problem in New Jersey and basic lead arsenate has proved practically non-injurious to peach trees in other States, preliminary investigations were carried out in New Jersey in 1942 to compare the effect of the two arsenates on peach trees and their compatability with various chemicals usually present in

insecticide and fungicide spray mixtures, either as necessary ingredients or as impurities. In field experiments on seven-year-old peach trees, acid lead arsenate caused severe injury to the trees when applied three times at a concentration of 2 lb. per 100 U.S. gals., alone or with 8 lb. hydrated lime and appreciable injury when applied seven times at the same rate but with 16 lb. hydrated lime, whereas basic lead arsenate caused none when applied seven times at the same concentration or three times at double the concentration, with 0, 8 or 16 lb. hydrated lime.

In laboratory experiments, acid lead arsenate at 3 lb. per 100 U.S. gals. and basic lead arsenate at 3 or 4 lb. per 100 U.S. gals. were mixed with various concentrations of a number of compounds including those that are normally present in spray waters, insecticides, fungicides, spreaders and adhesives, allowed to stand for about 24 hours at room temperature with frequent shaking, filtered and analysed for the presence of water soluble arsenic (As_2O_5). The basic compound was much the more stable ; of some 25 chemicals tested, only sodium phosphate, hydrogen sulphide and sodium sulphide resulted in the formation of more than 0·75 per cent. soluble arsenic (the proportion allowed by the Federal Insecticide Act for commercial lead arsenate) from basic lead arsenate, whereas 18, including carbonates, lime-sulphur, soap, hard waters, silicates and borax, did so from acid lead arsenate. It appears, therefore, that the lack of arsenical injury to peach trees from basic lead arsenate may be due primarily to its high degree of stability in spray mixtures.

In tests with solutions with pH values ranging from 1·1 to 12·1, the basic salt was stable in solutions ranging from pH 2 to 11·2, whereas the acid salt was stable only between pH 3·3 and 8·5, and the latter gave larger quantities of soluble arsenic at hydrogen-ion concentrations at which both decomposed.

Grayson (J. M.) & King (E. W.). **The Toxicity of Ethide to the Firebrat and three Species of stored Grain Insects.**—*J. econ. Ent.* **36** no. 4 pp. 540–543, 2 figs., 7 refs. Menasha, Wis., 1943.

As a result of laboratory fumigation tests with 1,1-dichlor-1-nitroethane (manufactured under the name of Ethide) against adult insects, the concentrations calculated to give 50 and 99 per cent. mortality after an exposure of five hours were 1·33 and 2·62 mg. per litre for *Thermobia domestica*, Pack., 2·75 and 4·44 for *Oryzaephilus surinamensis*, L., 2·23 and 3·88 for *Rhizopertha dominica*, F., and 2·01 and 3·47 for *Bruchus* (*Callosobruchus*) *maculatus*, F. ; those required to give the same mortalities of *T. domestica* after exposure for 2 hours were 2·79 and 4·4. Statistical analysis showed that the observations made on the first three insects varied no more from the calculated dosage-mortality curves than would be expected from simple fluctuations in sampling, but that those on the Bruchid were inconsistent with the curve, probably because of the high mortality (12·56 per cent.) in the control. The fumigant exhibited a delayed action that became more pronounced as its concentration decreased. No difficulty was experienced in evaporating it at the concentrations employed [*cf. R.A.E.*, A **30** 192].

Hodson (A. C.). **Lures attractive to the Apple Maggot.**—*J. econ. Ent.* **36** no. 4 pp. 545–548, 4 refs. Menasha, Wis., 1943.

Preliminary studies completed in 1941 having shown that several decomposing protein baits [*cf. R.A.E.*, A **28** 468] were much inferior to one of 1 per cent. glycine in 1 per cent. sodium hydroxide solution [**30** 132] for use against *Rhagoletis pomonella*, Walsh, on apple in Minnesota, the glycine bait was tested further and compared with several other chemicals in 1942. Open containers were used as traps since they proved much superior to a glass fruit-fly trap. When glycine traps were installed in the orchard for 2, 4 and 6 weeks before

being tested, 939 flies were caught in ten days, 700 of them in the oldest preparation ; the superiority of the latter persisted through the period, and there was no significant difference between the catches of those that had hung for two and four weeks, which attracted slightly more than fresh material. In preliminary tests, traps containing 1 and 2 per cent. household ammonia, 1 per cent. ammonium sulphate and the fresh glycine bait caught 375, 73, 93 and 64 flies, respectively. The addition of 0·1 per cent. granulated soap to the glycine bait nearly doubled the catch of flies, by lowering the surface tension of the material and enabling it to wet the flies more rapidly, so that they could not escape, and the glycine bait with and without soap, 1 per cent. household ammonia with and without soap and ammonium sulphate caught 229, 140, 1,385, 101 and 523 flies, respectively, during 21st–28th August 1943. The addition of soap to household ammonia not only prevented flies from escaping easily, but retarded the liberation of ammonia, and additional tests indicated that the solution of household ammonia and soap could be used effectively for as long as two weeks. The addition of soap also increased the attractiveness of ammonium sulphate and ammonium acetate, and there was no significant difference in the catch with these and household ammonia when Dreft was substituted for soap.

Indirect evidence of the effectiveness of the trapping was obtained by installing some traps when the first flies were observed and additional ones in neighbouring untreated trees each week after for five weeks, all the traps being allowed to remain in their initial positions until the end of the experiment. The glycine bait was used and was renewed weekly. The traps caught more flies each week until the peak of emergence, but after this, catches in each trap were greater during the first week after it was installed than in subsequent weeks and greater than those in surrounding traps that had been hanging longer, indicating that flies had accumulated in the absence of traps and were materially reduced in numbers by the subsequent trapping. Moreover, the number of larvae per apple in trees that carried traps throughout the season was rather less than a third of that in control trees. Trapping accurately reflected the progress of fly emergence, and 68·6 per cent. of the flies caught were females ; there is evidently little time between emergence and capture, as many of the flies caught were less than 15 hours old, and in view of the relatively long preoviposition period, the timing of spray applications may be based on catches.

Very few insects other than *R. pomonella* were attracted by any of the baits used.

Chisholm (R. D.) & Koblitsky (L.). **Sorption of Methyl Bromide by Soil in a Fumigation Chamber.**—*J. econ. Ent.* **36** no. 4 pp. 549–551, 1 fig., 1 ref. Menasha, Wis., 1943.

Fumigation with methyl bromide is one of the methods authorised in the United States for eradicating the Japanese beetle [*Popillia japonica*, Newm.] from plant material, with or without soil, but as the space occupied by the load is included in that specified in the dosage, and this and the type of soil and its moisture content are not constant, investigations were carried out to ascertain the effect of these variables on the amount of methyl bromide in the atmosphere of a fumigation chamber throughout the period of treatment and on the weight of the fumigant taken up by the soil. The concentration of gas in a fumigation chamber was determined at intervals for six hours after the release of methyl bromide at the rate of 2 lb. per 1,000 cu. ft., when the chamber was empty and dry, when it contained more than enough moisture to saturate its atmosphere and when it contained soil in quantities greater than would normally be encountered in practice. It was found that the initial concentration and rate of decrease in concentration were the same whether the air was dry or saturated with water. The concentrations in the atmosphere of the chamber when it contained dry sand, clay and peat were 112, 110 and 108 per cent. of that in

the empty chamber immediately after fumigation began and 102, 83 and 59 per cent. after six hours. The soils took up a maximum of 9, 25 and 41 per cent. of the methyl bromide released. When the soils were wet they took up less and the concentration in the chamber atmosphere was higher in each case. It is concluded therefore that the effect of methyl bromide fumigation on certain plants and its insecticidal value against insects in soil may be variable, and it is suggested that the rate at which the gas escapes from different soils after fumigation may be influenced by the same factors.

Easter (S. S.) & Phillips (G. L.). **Effect of Fumigation with Methyl Bromide and Paradichlorobenzene on Germination and Productivity of seed Sweet Potatoes.**—*J. econ. Ent.* **36** no. 4 pp. 552–554, 3 refs. Menasha, Wis., 1943.

An account is given of experiments carried out in Louisiana in 1939–40 to observe the effect on seed sweet potatoes of fumigating them with methyl bromide at a temperature of 70°F. for the control of *Cylas formicarius elegantulus*, Summers [*cf. R.A.E.*, A **29** 413] and keeping them at this temperature for 8–9 days after treatment, which was found to be necessary for adequate control; of keeping them at 70°F. for 8–9 days; and of fumigating them with paradichlorbenzene [*cf.* **25** 183]. All commercial draws were pulled from all beds three times each season. Fumigation with methyl bromide at the rate of 45 oz. per 1,000 cu. ft. for 4 hours killed all the adult weevils, but only 86·8 and 85·5 per cent. of the larvae and pupae, respectively, and this treatment and heating alone increased the total production of draws per plot from 20,641 to 21,462 and 21,085, respectively. Methyl bromide at 55 oz. per 1,000 cu. ft. for 5 hours gave complete mortality of all stages, but decreased the total number of draws to 17,398, though in 1940, when carefully selected seed stock was used, the production of draws was not reduced. Treatment with 1 oz. paradichlorbenzene per crate (50 lb.) for about 21 days at 50°F. or less and 60°F. did not give complete mortality and reduced the number of draws to 17,510 when carried out immediately before planting and 19, 615 and 6,278 when followed by storage at 70°F. for eight days and by immersion in water for 24 or 48 hours, respectively, before planting.

Wilcox (J.). **Practical Field Tests of Oils and Oils containing other Insecticides for the Control of the Earworm in southern California.**—*J. econ. Ent.* **36** no. 4 pp. 554–557, 1 fig., 6 refs. Menasha, Wis., 1943.

The author describes field tests in southern California on the control of *Heliothis armigera*, Hb., in sweet maize by injecting various oils, alone and in combination with pyrethrins or dichlorethyl ether, into the ears [*cf. R.A.E.*, A **31** 274, etc.]. In 1940, a mineral oil (viscosity 185 secs. Saybolt at 100°F.) alone or with 0·2 per cent. pyrethrins as oleoresin of pyrethrum, and a commercial mixture stated to contain the same concentration of pyrethrins in an oil having a viscosity of 100 secs. Saybolt and 99 per cent. unsulphonated residue were used, and 0·75 cc. was injected into each ear. The first application was made when about 60 per cent. of the ears were pollinated, and treated ears were marked and avoided at the second application, 4–5 days later, each ear receiving only one injection. The two oils containing pyrethrins gave approximately the same result, and both were more effective than oil alone. In 1941, oil (100 secs. viscosity) containing 2 per cent. dichlorethyl ether was tested in addition to the two oils containing pyrethrins. It was less effective than the latter, but the difference was not significant. Where the same method was used as in the previous year, the oil caused no measurable injury to the plants, but where the first application was made when about 40 per cent. of the ears were fertilised and second and third ones at intervals of 3–4 days, both insecticides

caused injury, owing to premature treatment of many ears; dichlorethyl ether was more injurious than pyrethrum, and the 100-viscosity oil more injurious than the other. The cost of treatment is discussed, and it is concluded that oil containing 0·2 per cent. pyrethrins, which consistently protected 80 per cent. or more of the ears, is superior to oil alone and to oil containing 2 per cent. dichlorethyl ether when applied at 0·75 cc. per ear, and that in southern California it is necessary to apply the treatment to the most fully developed ears when about 60 per cent. are pollinated and to the remainder 4–5 days later.

Fletcher (R. K.) & Thomas (F. L.). **Natural Control of Eggs and first instar Larvae of** *Heliothis armigera*.—*J. econ. Ent.* **36** no. 4 pp. 557–560, 2 refs. Menasha, Wis., 1943.

Observations made in 1932–33 and 1937–40 on variations in the infestation of cotton by *Heliothis armigera*, Hb., in three different typical cotton-growing localities in Texas indicated that 1·2–15·2 per cent. of the eggs were parasitised, 15·3–32·9 per cent. were destroyed by predators, and 11·2–43·7 per cent. were dislodged by wind, rain or cultivation or could not be accounted for. The percentages of first-instar larvae lost because of wind, cultivation or other causes varied from 6·6 to 87·4, and of those destroyed by predators from 12·6 to 59·6. *Orius insidiosus*, Say, which breeds in great numbers on maize silks and disperses when the maize matures to cotton and other vegetation, where it apparently continues to breed, destroyed 7·5–28·3 per cent. of the eggs and 23·3–52·3 per cent. of the larvae, as compared with the larvae of lace-wings, which destroyed 0–3·9 per cent. of the eggs, spiders (3·5–11·7 per cent. of the larvae) and unknown predators (0–10·1 per cent. of the eggs).

Calculations of the greatest possible number of larvae alive one day after hatching indicated a variation in natural control that helps to explain variations in injury that cannot be accounted for by differences in oviposition; it is estimated that not more than 61 per cent. develop beyond the first instar under field conditions.

Cox (J. A.), Bobb (M. L.) & Hough (W. S.). **A fungous Disease of the Comstock Mealybug.**—*J. econ. Ent.* **36** no. 4 pp. 580–583, 1 fig., 3 refs. Menasha, Wis., 1943.

The authors discuss the effect of weather conditions on the population of *Pseudococcus comstocki*, Kuw., on apple in three localities in Virginia in 1940–42, and the mortality of the mealybugs caused by fungous disease. The fungus in question was similar to one recorded from the mealybug on *Catalpa* in 1923 and identified as the *Isaria* stage of *Cordyceps clavulata* [*cf. R.A.E.*, A **13** 568], but it has been considered to represent a new species for which the name *Endosclerotium pseudococcia* has been proposed [*cf.* **30** 227, etc.]. It was not observed in apple orchards before 1940 and appears to be favoured by warm wet weather, lasting for several days, and a heavy mealybug infestation; it killed large numbers of mealybugs during rainy periods, except when the population consisted chiefly of eggs.

Watkins (T. C.) & Logan (S. H.). **Reduction of Flea Beetle Injury to Tomato Transplants by Treatment prior to Setting.**—*J. econ. Ent.* **36** no. 4 pp. 584–586, 2 refs. Menasha, Wis., 1943.

In view of the fact that when the peak of emergence of *Epitrix cucumeris*, Harr., occurs during the few days after tomato seedlings are transplanted injury may be so severe as to necessitate spraying or dusting, either of which is expensive and wasteful, preliminary tests were made in New York in 1942 of treatments to be applied before transplanting. The seedlings were set out in plots on

the day following treatment. Nearly all the dusts and sprays tested gave significant reductions in the number of feeding punctures; of 19 treatments used against the first brood, a derris-talc dust (1 per cent. rotenone) and sprays of 6 lb. calcium arsenate per 100 U.S. gals. and of Volck oil emulsion (1 : 100) gave the greatest average reduction in punctures without injuring the plants, and of 14 tested against the second brood, NNOR [mannitan monolaurate containing 1 per cent. rotenone] (1 : 400) with 2 lb. calcium arsenate per 100 U.S. gals., NNOR (1 : 400) alone, Volck oil emulsion (1 : 100) and Bordeaux mixture (4 : 2 : 50) were the most effective. Relative efficiencies were not reflected in yields, however, and this type of treatment is therefore not suggested for general use, although when tomato seedlings are to be planted out during periods in which flea-beetles are extremely abundant, it may afford valuable protection.

Watkins (T. C.) & Miner (F. D.). **Flight Habits of Carrot Rust Flies suggest possible Method of Control.**—*J. econ. Ent.* **36** no. 4 pp. 586–588, 4 refs. Menasha, Wis., 1943.

Observations on the populations of *Psila rosae*, F., present in celery fields in New York in 1941 and 1942 indicated that the numbers of flies visible increased markedly as the velocity of the wind and the brightness of the sunlight decreased and that they preferred the darkest shade available [*cf. R.A.E.*, A **31** 24, 229]. Spraying a young maple tree adjacent to an infested celery field with 2 U.S. gals. of a mixture of 5 lb. calcium arsenate and 100 U.S. gals. water on 27th May 1942 resulted in the collection of 74 dead flies in 13 days in a net spread under the tree, and a second application on 9th June in an additional 26 dead flies in 7 days. Most of them had probably been killed by the poison since the mortality of flies caged on sprayed and unsprayed branches was 80 and 0 per cent. in two days, respectively. Dusting carrot plants with calcium arsenate and a proprietary pyrophyllite (20 : 80) after adults of the first generation began to emerge on 29th July gave inconsistent results, owing to migration between the borders and centres of fields. It is recommended that planting should be delayed until flies of the overwintering generation have begun to oviposit, that an open field as far as possible from that planted in the previous year should be used and that insecticides should be applied to the surroundings of the latter during emergence of overwintered adults (approximately 25th May to 15th June in western New York) and to those of the current field during late July and August to kill flies emerging during these months.

Harrison (P. K.) & Brubaker (R. W.). **The relative Abundance of Cabbage Caterpillars on Cole Crops grown under similar Conditions.**—*J. econ. Ent.* **36** no. 4 pp. 589–592, 3 figs. Menasha, Wis., 1943.

The following is substantially the authors' summary. Three experiments were carried out in Louisiana in the autumns of 1939–41 to determine the relative abundance of the larvae of *Plusia* (*Autographa*) *brassicae*, Ril., *Pieris rapae*, L., and *Plutella maculipennis*, Curt., on green and red cabbage, collards, cauliflower, kale, broccoli, brussels sprouts and kohlrabi. The number and species of caterpillars and pupae on 20 plants per plot were recorded at weekly intervals. In all three experiments red cabbage was more heavily infested than green cabbage; broccoli and collards supported the largest total populations. General observations indicated that the number of larvae supported by the plants was largely due to factors other than the type of *Brassica*, and consequently that the relative abundance of the species is not an accurate indication of food-preference. It is noteworthy, however, that no outstanding resistance to these species was shown by any of the types of *Brassica* employed in the tests.

Sievers (A. F.), Lowman (M. S.) & Russell (G. A.). **Factors affecting the Rotenone Content of Devil's Shoestring.**—*J. econ. Ent.* **36** no. 4 pp. 593–598, 7 refs. Menasha, Wis., 1943.

The following is largely the authors' summary. Extensive surveys have shown that *Tephrosia virginiana* contains rotenone only in a few restricted areas in its range in the United States and that there are always some plants in such areas that lack it [*cf. R.A.E.*, A **26** 749]. To determine whether this variation is due to environment or is a genetic character, experiments were carried out with seedlings and crown divisions. Seeds from three localities were sown at Arlington, Virginia, where no wild plants have been found to contain rotenone. Comparison of the resulting roots indicated that environment did not prevent rotenone from forming in the plants grown from seed from north-eastern Texas and Cordell, Georgia, where most of the plants contain rotenone, but that the progeny of plants in Ingram, Virginia, where no plants have been found to contain more than a trace of rotenone, did not develop any. The crowns of plants of known quality from Milano, Texas, where most of the wild plants contain rotenone, were divided and replanted in the same locality and at Arlington in one test and in the same locality and at Tifton, Georgia, where wild plants sometimes contain rotenone, and at Columbia, South Carolina, where they seldom if ever contain any, in another. The rotenone contents of the plants in Virginia and Georgia after two seasons of growth were in most cases equal to those of the plants in Texas, but in South Carolina some unknown condition evidently prevented rotenone formation in the plants except for a few at the end of the row.

The experiments appear to show that in general there are certain strains of the species that have the capacity to produce rotenone under most conditions but that certain environmental conditions not yet understood can greatly modify this capacity.

Ewing (K. P.). **Cotton Aphid Damage and Control in Texas.**—*J. econ. Ent.* **36** no. 4 pp. 598–601, 1 ref. Menasha, Wis., 1943.

An account is given of experiments carried out in Texas in 1942 on the control of *Aphis gossypii*, Glov., and the reduction it causes in the yield of cotton. The materials tested were calcium arsenate, basic copper arsenate, synthetic cryolite and nicotine from nicotine sulphate; 5 per cent. hydrated lime was added to the calcium arsenate and cryolite when nicotine sulphate was used, to provide sufficient free lime to liberate the nicotine. All applications, with the exception of one series, were made early in the morning. All the dusts controlled injurious infestations of the boll weevil [*Anthonomus grandis*, Boh.] and the bollworm [*Heliothis armigera*, Hb.], and differences in yields were due chiefly to Aphid infestation. The yields of seed cotton on untreated plots in the three experiments were 977, 842 and 705 lb. per acre. In the first experiment, in which the plots were dusted eight times between 10th July and 13th August, only cryolite alone and cryolite and calcium arsenate with 1 per cent. nicotine gave significant increases in yield (219, 234 and 222 lb. seed cotton per acre); plots treated with calcium arsenate alone or with sulphur (1 : 2) and 0·5 per cent. nicotine had significantly higher populations of Aphids and yielded slightly less than the control plot. In the second, in which applications were made on the same dates, alternate applications of calcium arsenate alone and with 2 per cent. nicotine resulted in significantly lower Aphid infestation than calcium arsenate alone or with 0·5 per cent. nicotine, or than calcium arsenate with 1 per cent. nicotine applied at midday, and increased the yield by 264 lb. per acre, as compared with 134, 83 and 84 lb.; calcium arsenate with 1 per cent. nicotine applied in the early morning resulted in a gain of 194 lb. In the third experiment, seven applications were made between 11th July and

12th August. Calcium arsenate with 0·5 per cent. nicotine permitted considerable increase of the Aphid, which caused premature shedding of about 50–75 per cent. of the leaves; calcium arsenate with 1 per cent. nicotine permitted little increase until late in the season, when migration occurred from the plot treated with calcium arsenate and 0·5 per cent. nicotine and there was some damage and leaf drop. Aphids increased somewhat and produced honeydew on the lower leaves of plants dusted with basic copper arsenate and sulphur (1 : 2), but no noticeable injury was caused. Yield records showed gains of 64, 232 and 523 lb. per acre, respectively, from the three treatments. Basic copper arsenate was as effective as calcium arsenate against *Heliothis* and *Anthonomus*, and it is possible that part of the increase in yield on plots treated with it may have been due to increased residual control of these pests late in the season [*cf. R.A.E.*, A **31**, 467].

Ewing (K. P.) & Ivy (E. E.). **Some Factors influencing Bollworm Populations and Damage.**—*J. econ. Ent.* **36** no. 4 pp. 602–606, 11 refs. Menasha, Wis., 1943.

Observations made in Texas since 1928 have shown that although infestations of *Heliothis armigera*, Hb., on cotton can be controlled by timely heavy applications of calcium arsenate, they may become greater on plants that receive applications that are ill-timed or too light than on undusted ones. The increase is frequently associated with increased populations of cotton Aphids [*Aphis gossypii*, Glov.], and may be due partly to the attraction of the moths to honeydew for food [*cf. R.A.E.*, A **31** 467]. In cage tests, several Coccinellid predators of the bollworm and the Aphid were killed by arsenicals, and the daily consumption of bollworm eggs was considerably reduced in the case of *Orius insidiosus*, Say, *Hippodamia convergens*, Guér., and *Collops balteatus*, Lec., and somewhat reduced in the case of *Scymnus creperus*, Muls., and *Chrysopa* sp. when Aphids were present as alternative food [*cf. loc. cit.*]. Although a normal hatch of eggs occurred in cages containing *Zelus renardi*, Kol., none of the larvae reached the second instar when this predator was present.

Ewing (K. P.) & Parencia jr. (C. R.). **Dosages of Insecticides to control the Boll Weevil and the Bollworm.**—*J. econ. Ent.* **36** no. 4 pp. 607–610, 2 refs. Menasha, Wis., 1943.

Field-plot experiments were carried out in Texas in 1942 to determine whether reduced dosages of calcium arsenate would give effective control of *Anthonomus grandis*, Boh., and whether it could be replaced by cryolite, and to compare the control of *Heliothis armigera*, Hb., given by calcium arsenate, cryolite, lead arsenate and basic copper arsenate at approximately 8 lb. per acre and by increased dosages of calcium arsenate and decreased dosages of basic copper arsenate. The calcium arsenate, lead arsenate and basic copper arsenate used contained 40·4–42·4, 32·8 and 38·7 per cent. total arsenic pentoxide and 3·5–11·1, 0·47 and 0·1 per cent. water-soluble arsenic pentoxide, respectively, the synthetic cryolite contained 85·1–87·4 per cent. sodium fluoaluminate, and the sulphur was 84·6–96 per cent. pure. In the two experiments against *A. grandis*, infestation by it was too light to show marked differences in yield between plots treated with calcium arsenate, cryolite and various mixtures of these with sulphur, but in the second experiment, calcium arsenate and sulphur (1 : 1, 1 : 3 and 1 : 7) reduced the percentages of squares punctured to 11·7, 11·9 and 12 as compared with 13·3, 15·6 and 12·8 for similar mixtures of cryolite and sulphur and 20·9 in the controls. In this experiment, *H. armigera* was injurious and was more effectively controlled by cryolite than by calcium arsenate. The increases in yield over the control (844 lb. seed cotton per acre) averaged 159 lb. for the three cryolite dusts and 55 lb. for the three mixtures of calcium arsenate.

In the two experiments on the control of *H. armigera*, boll weevils, fleahoppers [*Psallus seriatus*, Reut.] and Aphids [*Aphis gossypii*, Glov.] caused no appreciable damage. In one, calcium arsenate at the rate of 8·2, 12·4 and 15·8 lb. per acre resulted in increases in yield of 225, 275 and 397 lb. per acre over the control (835 lb.) and basic copper arsenate and sulphur (1 : 1 and 1 : 2) at 16 lb. mixed dust per acre in increases of 371 and 273 lb. In the other, the increases in yield over the control (592 lb. per acre) due to applications of approximately 8 lb. per acre of basic copper arsenate (diluted with an equal amount of sulphur), lead arsenate or cryolite (462, 446 and 442 lb.) were significantly higher than that due to similar applications of calcium arsenate (252 lb.).

BARBER (G. W.). **Oviposition Habits of the Earworm Moth in Relation to Infestation in the Ears and to Control.**—*J. econ. Ent.* **36** no. 4 pp. 611–618, 2 refs. Menasha, Wis., 1943.

The following is based on the author's summary. Records of oviposition by *Heliothis armigera*, Hb., obtained in central Virginia during 1925–27 showed that eggs were deposited on all parts of plants of field and sweet maize during all stages of their growth, regardless of the population levels of the eggs. The larvae that hatch before the silks are exposed feed on whatever parts of the plant are most attractive at the time of hatching, the most suitable being the tender leaves of the whorl and the green tassel. Such larvae begin to migrate to the silks almost immediately after they are exposed, and many ears may be entered before dusts or sprays can be applied. This migration may last several days and constitutes one of the greatest difficulties in the control of the insects in the ears. When the eggs are laid abundantly or indiscriminately, such measures as removing the silks or clipping the tip of the husks from the ears are ineffective, as migrating larvae reinfest the ears almost at once.

A comparison of the number of kernels injured in ears of plants on which varying numbers of eggs were deposited showed that although the extent of kernel injury was not closely correlated with the number of eggs on the plant, it was correlated with the number deposited on the silks. A study of the proportions of the egg populations destroyed by *Trichogramma minutum*, Ril., and *Orius insidiosus*, Say, showed that, in general, the effectiveness of each of these natural enemies increased with the population of host eggs.

SMITH (C. E.), ALLEN (N.) & NELSON (O. A.). **Some chemotropic Studies with *Autographa* spp.**—*J. econ. Ent.* **36** no. 4 pp. 619–621. Menasha, Wis., 1943.

The following is substantially the authors' summary. In experiments carried out at Baton Rouge, Louisiana, in 1926–30, light traps, bait pans and more than 500 compounds, mostly aromatic chemicals, exposed in trap cages, were tested as possible means of destroying the adults of *Heliothis armigera*, Hb. (tomato fruitworm) and *Plusia* (*Autographa*) *brassicae*, Ril. (cabbage looper) before they oviposited. The results with *H. armigera* were largely negative, but several of the chemicals strongly attracted *P. brassicae* and certain closely related species when exposed in suitable trap cages.

The most attractive chemicals were phenylacetaldehyde, benzyl ether, benzyl acetate, palmitaldehyde, diphenyl ether and benzyl valerate, but in tests comparing the original and three or four distillation fractions, including the residue, the purest fractions were most attractive only in the cases of benzyl ether and phenylacetaldehyde. Of the other chemicals, the original of diphenyl ether, first fractions of benzyl isovalerate and palmitaldehyde, and the residue of benzyl acetate were the most attractive. Several other chemicals, or impurities

contained in them, were slightly attractive. A 10 per cent. solution of phenylacetaldehyde in diethyl phthalate caught as many moths as the undiluted chemical, but similar solutions in ethyl alcohol and a proprietary solvent were less attractive. Approximately half the moths caught in the chemically baited cages were females, and a large proportion of these were gravid.

LEVIN (C.). **The Effect of Tobacco Plant-bed Construction on the Development of Flea Beetle Populations.**—*J. econ. Ent.* **36** no. 4 pp. 622–623, 2 refs. Menasha, Wis., 1943.

The tobacco seed beds commonly used in North Carolina are of three types. The open type has no side walls and the cloth cover is pegged down at the sides ; the pole type has side walls of pine logs to which the cover is attached ; and the closed type has walls of well fitted boards over which the cover is drawn and fastened. Since the moist sheltered beds of tender plants are important breeding places for *Epitrix parvula*, F. [*cf. R.A.E.*, A **29** 201], the comparative effectiveness of the three types in protecting the seedlings from invasion by it, estimated on the basis of the populations of adults developing in them, was investigated in 1940 and 1942. More than three times as many beetles of the spring brood developed in the open- and pole-type beds as in the closed ones.

LIST (G. M.). **Results of 1942 Experiments for Control of the Mexican Bean Beetle at Fort Collins, Colo.**—*J. econ. Ent.* **36** no. 4 pp. 624-625. Menasha, Wis., 1943.

Experiments carried out in Colorado in 1942 on the control of the Mexican bean beetle [*Epilachna varivestis*, Muls.] are described. Sprays were applied at approximately 125 U.S. gals. and dusts at about 20 lb. per acre on 25th–26th June, when the first set of true leaves was well formed, on 9th–10th July, when the plants were about 10 ins. tall, and on 24th–25th July, when a few pods were about half grown. Injury from adults was rather severe at the time of the first applications, and about 1·15 beetles and 1·44 egg masses per foot of row were found. Plots sprayed with 2 lb. zinc arsenite per 100 U.S. gals., which is the spray commonly used against *E. varivestis* in Colorado, were used as controls, since the infestation was too severe for untreated plots to be left for comparison. In the first experiment, there was no significant difference in yield between plots treated with sprays containing 2·5 lb. cubé (5 per cent. rotenone), alone or with 10 oz. Lethane 60 (a 50 per cent. solution in a petroleum carrier of β-thiocyanoethyl esters of aliphatic fatty acids with 10–18 carbon atoms), 1·25 lb. cubé with 5 oz. Lethane 60, 3 lb. copper arsenate or 6 lb. natural cryolite, per 100 U.S. gals., which all resulted in significantly higher yields than did zinc arsenite. There was no significant difference between dusts containing 0·5 per cent. rotenone or 10 per cent. Pyrocide (an oil extract of pyrethrum absorbed in clay and containing 2 per cent. pyrethrins) and the zinc-arsenite spray, but a Pyrocide dust containing 0·15 per cent. pyrethrins was significantly less effective. Increases in yield were generally correlated with decreases in the numbers of larvae except in the case of zinc arsenite, which gave effective control of the larvae, but caused arsenical scorching that reduced the yield by 300-500 lb. per acre. The two most concentrated cubé sprays gave significantly greater reductions in larval populations than any other except that containing copper arsenate, but did not differ significantly between themselves. Cubé was significantly more effective in sprays than in dusts, and the pyrethrum dusts were the least effective. Copper arsenate delayed maturity of the beans by 4–6 days.

In the second experiment, 4 lb. phenothiazine per 100 U.S. gals. resulted in a significantly higher yield than zinc arsenite, while sprays of 6 lb. natural or synthetic cryolite or 2 lb. calcium arsenate per 100 U.S. gals. did not differ

significantly from it, and 3 lb. magnesium arsenate per 100 U.S. gals. gave significantly poorer results. Calcium arsenate and zinc arsenite both caused noticeable injury to the plants.

From these results it is concluded that natural and synthetic cryolite are the most promising of the materials that are still readily available for the control of *Epilachna*.

VANSELL (G. H.). **The Wax Moth as a Household Pest.**—*J. econ. Ent.* **36** no. 4 pp. 626–627, 3 refs. Menasha, Wis., 1943.

The author gives a short account of the life-history of *Galleria mellonella*, L., and reports that after a colony of honeybees in the walls of a house in California had been fumigated with calcium cyanide to exterminate the bees, larvae of this moth drilled through the board walls and wallpaper and many cocoons were found behind picture frames and other objects in the house. Stray bee colonies are frequently found in dwellings, and when the bees have been killed, old combs should be removed to prevent outbreaks of larvae of *Galleria* that may be present in them [*cf.* also *R.A.E.*, A **29** 418].

BOWEN (C. V.) & BARTHEL (W. F.). **Nornicotine in commercial Nicotine Sulfate Solutions.**—*J. econ. Ent.* **36** no. 4 p. 627, 3 refs. Menasha, Wis., 1943.

Analysis of various samples of tobacco (*Nicotiana tabacum*) and *N. rustica* and of two commercial samples of nicotine sulphate showed that nornicotine was present in all of them and comprised nearly 12 per cent. of the alkaloid content of one of the samples of nicotine sulphate that was reported to have been much more toxic to Aphids on cotton than had been expected. Commercial nicotine-sulphate solutions and tobacco extracts containing nornicotine may be expected to be better contact insecticides than solutions of pure nicotine sulphate [*cf. R.A.E.*, A **29** 353], but nornicotine is less volatile than nicotine, and when a mixture of the two is used as a fumigant by burning or by spraying on a heated surface, the predominant effect is probably that of nicotine. The presence of nornicotine in varying amounts in materials that have been considered to be pure nicotine products may therefore account for erratic and non-reproducible results in insect control.

HOVEY (C. L.). **Effects of Temperature and Humidity on certain developmental Stages of the Potato Tuber Moth.**—*J. econ. Ent.* **36** no. 4 pp. 627–628, 1 ref. Menasha, Wis., 1943.

In laboratory tests carried out in Minnesota in 1941 to determine the effect of temperature and humidity on the rate of development of various stages of *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., no eggs kept at 10°C. [50°F.] completed their development, but those kept at 15°C. [59°F.] and 2·2–80·4 per cent. relative humidity hatched in averages of 17·4–18 days and those at 20°C. [68°F.] and 0–100 per cent. relative humidity in 8·2–8·7 days, indicating that at these temperatures humidity has no appreciable effect on the length of the incubation period. Only 5 of 266 full-grown larvae that developed at room temperature (about 25°C. [77°F.]) were able to pupate when kept at 5°C. [41°F.], and, at the end of 117 days, when the experiment was terminated, only one adult had emerged from 52 pupae that were formed at room temperature and then kept at 5°C., though the remainder were in excellent condition. None emerged from 61 pupae stored for about 7 months at 10°C. and various humidities, including extremes, but 4 emerged in 26–28 days from 16 pupae stored at 15°C. and 2·2 per cent. relative humidity.

Fulton (R. A.) & Busbey (R. L.). **Apparatus for Laboratory Fumigation of the California Red Scale.**—*J. econ. Ent.* **36** no. 4 pp. 628–629, 2 figs., 1 ref. Menasha, Wis., 1943.

Details are given of a fumigation chamber developed for studying the toxicity of hydrocyanic acid gas to *Aonidiella aurantii*, Mask., in the laboratory, in which decreasing concentrations, similar to those that occur inside tents over *Citrus* trees, or constant or increasing concentrations of gas can be obtained. The method of operation is described.

Ditman (L. P.). **The Corn Earworm Infestation of 1942.**—*J. econ. Ent.* **36** no. 4 pp. 629–630, 2 figs. Menasha, Wis., 1943.

Heavy general infestations of the corn earworm [*Heliothis armigera*, Hb.] in Maryland occur as a result of two or more consecutive years favourable to hibernation. The winters of 1940–41 and 1941–42 were mild, favouring the survival of pupae in the soil, and infestation in 1942 was severe on early tomatos and sweet maize, and, in late summer and early autumn after the maize season, on snap and lima beans. Parasitism was very heavy; in one field, one or more eggs of an undetermined Tachinid were noted on each larva observed in late September and early October.

Control experiments carried out on the beans showed that rotenone-bearing dusts at 30–60 lb. per acre and calcium-arsenate dusts at 30–63 lb. per acre were ineffective, and the latter damaged the plants. A dust of 80 per cent. cryolite and 20 per cent. sulphur reduced the percentage of pods infested from 29 to 9 on lima beans and from 21 to 2 on snap beans when used at 15–50 lb. per acre, but was ineffective at 11 lb.; the optimum practical rate of application appeared to be 20 lb. per acre.

Thomas (C. A.). **Belladonna Insects in Pennsylvania.**—*J. econ. Ent.* **36** no. 4 pp. 630–632. Menasha, Wis., 1943.

In view of the shortage of supplies from Europe, belladonna (*Atropa belladonna*) is being grown in Pennsylvania. The method of growing and harvesting the crop are briefly described, and a list is given of pests, including 29 species of insects, that were identified as feeding on the plant in a preliminary survey made during 1942, with notes on the degree and type of damage caused by each of them.

Gooden (E. L.). **Density and Particle Size of Derris and Cube Powders.**—*J. econ. Ent.* **36** no. 4 pp. 632–633, 6 refs. Menasha, Wis., 1943.

The use of the self-calculating air-permeation apparatus [*R.A.E.*, A **29** 397] for determining the particle fineness of insecticide powders involves a knowledge of the density of the powder particles, which varies with the state of subdivision in the case of porous materials such as derris and cubé. The rough estimate of the density of these materials formerly used (1 gm. per cc.) has been found adequate for comparing samples of these materials only, but a more accurate value is needed when they are compared with others of a different nature. The author therefore describes a method of determining the density by the use of a pycnometer with a liquid that wets the sample readily, the reading being taken as soon as possible in order to approach the ideal condition of permeation of interstices between particles without internal soaking of those that are porous. Water was found to give unsatisfactory results with derris, and toluene gave slightly higher average results than high-boiling refined kerosene, possibly owing to greater solvent action. With kerosene, the samples of derris and cubé tested gave densities of 1·34–1·45 gm. per cc., and it is concluded that 1·4 gm. per cc. is a practical estimate of representative density for both derris and cubé in a commercial powdered form.

The error in the value derived for average particle diameter is relatively greater than the density error that causes it, and both theory and observation have shown that in the range of porosities commonly occurring in commercial derris and cubé powders, the average value for the diameter calculated from the new density estimate is less than half that obtained from the former estimate. It is concluded, therefore, that in spite of the presence of coarse fibres, the common derris and cubé powders are rather fine as to average particle diameter, and appreciably finer than they were formerly considered to be.

Pepper (J. H.) & Hastings (E.). **Age Variations in exoskeletal Composition of the Sugar Beet Webworm and their possible Effect on Membrane Permeability.**—*J. econ. Ent.* **36** no. 4 pp. 633–634. Menasha, Wis., 1943.

Various pyrethrum dusts and sprays and also oil sprays were found to be very effective against the first- and second-instar larvae of *Loxostege sticticalis*, L., but progressively less so against those in later instars, being practically ineffective against the fifth. As this is probably due to changes in the exoskeleton rather than to physiological or morphological changes within the insect, exoskeletons of larvae in the third, fourth and fifth instars were analysed for ether-extractable fat, crude protein, chitin and ash. First- and second-instar larvae were not used owing to the difficulty of obtaining enough membranes to carry out the determinations. The data, which are given in a table, showed a decrease in fat contents of the exoskeleton from 11·7 to 3·9 and 0·2 per cent. in the successive instars, accompanied by an increase in the percentage of protein and to a less extent of chitin and ash, and it is pointed out that, if the hypothesis is valid that a membrane containing practically no fatty materials presents a much greater barrier to oil-soluble substances than one containing a considerable amount of fat, the exoskeletons of the third larval instar should be more permeable to both pyrethrum and oils than those of the fourth or fifth instars.

Bissell (T. L.). **The Confused Flour Beetle living in Bait Mixtures containing Cryolite.**—*J. econ. Ent.* **36** no. 4 pp. 634–635, 1 fig., 3 refs. Menasha, Wis., 1943.

A mixture of synthetic cryolite (85 per cent. sodium fluoaluminate) and maize meal (1 : 25), made in 1940 and stored in a paper bag, was found to contain a considerable infestation of *Tribolium confusum*, Duv., at all levels 2½ years later. The effect of three concentrations (1 : 25, 1 : 9 and 1 : 4) of synthetic and natural cryolite (85 and not less than 90 per cent. sodium fluoaluminate, respectively) in fresh maize meal and wheat flour and of the original mixture, after sifting through a 16-mesh screen, on larvae and adults from this infestation was tested under controlled conditions. They were kept at temperatures fluctuating from 37–59°F. at night to 70–75° in the day from 5th–18th December, and at 80–85°F. afterwards ; counts of living and dead insects were made by sifting them from the mixtures at intervals of 7–22 days until 8th February. Natural cryolite was somewhat less toxic than synthetic cryolite ; mixtures of 1 part of either in 25 parts meal gave low kills, more beetles dying in the original mixture than in the others, and many insects survived at the other concentrations. All flour mixtures gave complete kill of adults in 48 days and all but natural cryolite and flour (1 : 25), which gave 96 per cent. mortality, complete kill of larvae in 65 days, though mortality was lower in untreated flour than in untreated meal.

In most of the poison mixtures beetles died more quickly than larvae, though more larvae than adults died in the control mixtures. On 22nd January, the flour mixtures averaged 0·7 per cent. higher water content than the meal mixtures, and it is considered that the additional water in the former may have increased insect activity and thus caused higher mortalities. Development

and reproduction took place in the presence of cryolite, and it is concluded that *T. confusum* thrives in maize meal containing 4 per cent. cryolite or more and can survive for several weeks in mixtures of wheat flour and cryolite.

ALEXANDER (C. C.) & CARLSON (F. W.). **A Comparison of Codling Moth Captures by Bait Trap and Rotary Net.**—*J. econ. Ent.* **36** no. 4 pp. 637–638, 2 figs., 1 ref. Menasha, Wis., 1943.

In order to study the flight habits of the codling moth [*Cydia pomonella*, L.] when it is not attracted by lights or baits, an electrically operated rotary net was used in Washington in the summers of 1940–42. Two nets, 10 and 15 ft. above the ground, were rotated horizontally at the rate of about 20 miles an hour from 6 p.m. until about 8 a.m., in such a position that they swung as near to two apple trees as was possible without touching them. The catches in these were compared with those in two pans containing a fermented bait of beet molasses and water (1 : 9), placed about 15 ft. from the ground in trees 150 ft. north and 225 ft. south of the net. The upper net caught only 10 per cent. as many moths as the lower one and was not used after early 1941. The lower net caught 4,391, 5,471 and 2,616 moths in the three seasons as compared with 5,254, 5,896 and 2,566 per pan caught by the bait. In 1940, the catches in the lower net agreed well with those in the bait pans until the middle of August, but diminished more rapidly after this date ; in 1941 and 1942, they were greater than the averages per pan until about the beginning of August, after which they again diminished more rapidly. Throughout these two years, about 90 per cent. of the moths in the net and 65 per cent. of those in the pans were males, indicating that the females do not fly as freely as the males, and additional bait pans that just touched the periphery of the tree and were only about 10 ft. from the ground caught little more than half the numbers in the net or in the pans at the tops of trees ; only 56 per cent. of the moths in the lower pans were males. Of 350 dyed moths that were released in July and August 1942 about 165 ft. from the net and pans, 23 were recovered in the net and 46 in the two pans.

It is concluded that molasses baits generally give a good estimate of the number of moths flying about an orchard, but are apparently less attractive early in the season, when they may give a slight under-estimate, than later. Bait pans in scattered trees do not attract moths for any distance, since the net caught as many dyed moths as the average per pan.

HALLER (H. L.) & MCINDOO (N. E.). **The Castor-bean Plant as a Source of Insecticides.**—*J. econ. Ent.* **36** no. 4 p. 638, 9 refs. Menasha, Wis., 1943.

Although statements that the leaves of castor (*Ricinus communis*) are toxic to grasshoppers feeding on them have been refuted and tests have provided no evidence that the plant has any value for poisoning, repelling or trapping grasshoppers or any other insect pests of crops [*cf. R.A.E.*, A **29** 327, etc.], Holzcker reported in 1940 the extraction of a new insecticidal spray material from the leaves. The original insecticide was a liquid mixture of plant extractives and lime-sulphur solution, but more recently a powder has been made available. The results of controlled experiments with the material have not yet been published, and the active insecticidal constituent is not definitely known. Ricin, a toxic protein, and ricinine, an alkaloid, are known to occur in the seeds and other parts of the plant, but though both compounds are poisonous to vertebrates, little is known of their effect on insects ; tests have indicated that ricin is not toxic to grasshoppers, *Musca domestica*, L., or larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., but that ricinine is highly toxic to the last, though not to the others. N-isobutyl undecylene amide, which, although relatively non-toxic when used alone, increases the toxicity of pyrethrum insecticides

[*cf.* **31** 109], is prepared from undecylenic acid, obtained on pyrolysis of castor oil, and isobutylamine. It is possible that an insecticidal principle is present in the castor plant only under certain conditions of variety, cultural practice and environment, and the accepted use of this plant as a source of insecticide apparently awaits the isolation, identification and analysis of the specific substance or substances toxic to insects.

McFarlane (J. S.) & Rieman (G. H.). **Leafhopper Resistance among the Bean Varieties.**—*J. econ. Ent.* **36** no. 4 p. 639, 1 ref. Menasha, Wis., 1943.

In a preliminary study of the resistance of 27 varieties of snap and lima beans to *Empoasca fabae*, Harr., made in Wisconsin in 1941, in which the degree of injury was estimated when the most susceptible plants were severely stunted and showed very curled and puckered leaves, but before any appreciable injury occurred on the most resistant, the varieties showed a wide range in susceptibility, those that matured early being generally the most susceptible and those that matured late tending to be resistant.

Haviland (E. E.). **Hibernation and Survival of the Locust Leaf-miner.**—*J. econ. Ent.* **36** no. 4 pp. 639–640. Menasha, Wis., 1943.

The locust leaf-miner, *Chalepus dorsalis*, Thnb., hibernates in thick undisturbed masses of fallen deciduous leaves as near as possible to locust trees [*Robinia*]. In Maryland, emergence extends over several days in spring, depending to some extent on the exposure of the woods. In 1943, the first active beetles were found on 5th May on the leaves of apple trees growing near a grove of locust trees [*cf. R.A.E.*, A **30** 483] ; many were still present in leaf mould on a north slope, but none on a south slope where they had been common a week earlier. After two warm days they were numerous on apple, on which they continued to feed for two weeks. Small numbers were feeding on *Robinia* and some were seen resting on leaves of other trees.

Examination between 29th March and 5th May of cages containing oak and maple leaves, placed among leaf litter under conditions similar to those in the woods, showed that 88·23–92·27 per cent. of the beetles introduced between 1st December and 4th January were still alive.

McGarr (R. L.). **Relation of Fertilizers to the Development of the Cotton Aphid in 1941 and 1942.**—*J. econ. Ent.* **36** no. 4 p. 640, 1 ref. Menasha, Wis., 1943.

Investigations on the effect of treating land planted to cotton with nitrogenous fertilisers on the development of *Aphis gossypii*, Glov., carried out in Mississippi in 1941 [*R.A.E.*, A **31** 185] were repeated in the same locality in 1942 with similar results. Fertilisers containing fairly constant amounts of phosphoric acid and potash, alone or with different amounts of nitrogen, were applied at the same rate and time as before, and six applications of 6·3–6·9 lb. calcium arsenate per acre were made at five-day intervals from 10th July, when the first flowers appeared on the cotton. The increase in the number of Aphids was significant on all plants dusted with calcium arsenate, and the use of nitrogenous fertiliser resulted in a definite increase in population, correlated with the percentage of nitrogen in the fertiliser, when calcium arsenate was used, but caused no appreciable difference when it was not. Infestation by the boll weevil [*Anthonomus grandis*, Boh.] was negligible in all plots.

Yarwood (C. E.). **Sulfur Dust and Hop Aphids.**—*J. econ. Ent.* **36** no. 4 p. 641, 2 refs. Menasha, Wis., 1943.

Although pentathionic acid, which is possibly the active constituent involved in the fungicidal action of sulphur, has been shown to be toxic to Aphids

[*R.A.E.*, A **21** 314], sulphur is apparently not generally used for their control, and the sulphur dusts that are applied to hops against powdery mildew [*Sphaerotheca humuli*] in England and New York, where Aphids are also important pests, have not given any marked control of the insects. In 1938–41, however, sulphur dust used on hops in California in May and June for the control of hop downy mildew (*Pseudoperonospora humuli*) apparently gave some control of *Phorodon humuli*, Schr., and in 1942 and 1943, Aphid counts on experimental plots of hops that were thoroughly dusted with sulphur indicated that in three of four localities, the populations were reduced by nearly 95 per cent.; in the fourth locality, where temperatures were lower, the numbers were reduced by nearly 50 per cent. It was also observed that populations of *Anuraphis roseus*, Baker, were lower on apples dusted with sulphur than on undusted ones, and that mortality of this Aphid due to sulphur was greater in periods of hot weather.

In laboratory tests, pairs of opposite hop leaves bearing about 100 Aphids per leaf, one of which was dusted with sulphur, were placed in vials of water and kept at controlled temperatures in the dark for about 12 hours. In three tests, the average numbers of living Aphids on dusted and undusted leaves at the end of the experiment were 91 and 103 per cent. of those present before dusting at 16°C. [60·8°F.], 78 and 113 per cent. at 25°C. [77°F.], 21 and 111 at 31°C. [87·8°F.], 14 and 110 at 34°C. [93·2°F.] and 0·2 and 10 at 38°C. [100·4°F.], confirming observations that the kill of Aphids on apples and hops treated with sulphur is increased by high temperatures. The temperature factor would explain why sulphur kills hop Aphids in California and not in New York or England.

Cowan (F. T.), Shipman (H. J.) & Wakeland (C.). **Mormon Crickets and their Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1928, 17 pp., 11 figs. Washington, D.C., 1943.

Some of the information in this account of the life-history and economic importance of *Anabrus simplex*, Hald., which sporadically causes serious injury to crops and range forage plants in the Rocky Mountain States, is similar to that already noticed [*R.A.E.*, A **18** 284]. Its distribution in 1938, when the most recent outbreak reached a peak and infestation spread to Nebraska and the Dakotas, is shown on a map, and all stages are briefly described. The damage caused in this outbreak was greatly reduced by the control campaigns [*cf.* **28** 369–370]. In addition to garden and field crops, the Tettigoniid feeds on over 250 kinds of range plants, including 47 grasses and 180 weeds. Fleshy-leaved plants are preferred. Among crop plants, wheat, other cereals and lucerne are chiefly damaged, though vegetables, including sugar-beet, are preferred. The leaves of young wheat are shredded rather than eaten entirely, as by grasshoppers, and this causes thinning of the stand. On older plants the insects cut through the outer sheath and eat the inner parts so that the wheat head dries. On ripening and mature wheat the grains are removed and eaten. On lucerne, the entire leaf is consumed. Damage to range forage is most severe in Nevada, where over two million acres of sagebrush [*Artemisia*] and rabbitbrush [*Chrysothamnus*] were attacked in 1939, with a loss of up to 40 per cent. in stock-carrying capacity.

A. simplex persists in limited numbers in permanent breeding areas in mountain ranges and migrates from them when weather conditions become favourable for reproduction in adjacent country. Migration, which takes place at the rate of about ½ mile a day, or 25 miles in a season, occurs at air and ground temperatures of 65–95°F. and 75–125°F., respectively [*cf.* **29** 562]. It ceases when the wind velocity reaches 20–25 miles per hour. Feeding takes place within the same range of temperatures as migration [*cf.* **29** 428]. The eggs are laid in groups about an inch beneath the soil surface in bare spaces between grass

clumps or in the tops of clumps, on the warmer slopes, light sandy loam soils being preferred. Oviposition occurs over periods of 1–2 days, separated by resting periods of 4–6 days.

Following research begun in 1935 [*cf.* **30** 61], control by the use of poisoned bait has replaced other methods. For areas where infestation is moderate to heavy, the formula recommended is 4 lb. sodium fluosilicate and 12–15 U.S. gals. water per 100 lb. standard bran ; the bait dries out less quickly if 1–1½ U.S. gals. cheap lubricating oil is substituted for the water [*cf.* **30** 591]. For areas in which grasshoppers also occur, or where infestation by *A. simplex* is scattered, a cheaper bait consisting of 4 lb. sodium fluosilicate, 3½ bushels sawdust and 8–10 U.S. gals. water per 25 lb. mill-run bran is recommended. The sawdust is necessary to prevent the lumping that occurs when a bran that contains the shorts and middlings is moistened. Conifer sawdust should be kept for at least two years, but that from other trees can be used fresh. The baits are more effective if spread while the Tettigoniids are migrating. For populations of over 15, 15–5 and less than 5 per sq. yard, the quantities of bait required are 10, 5 and 2½ lb. dry weight per acre ; it should be applied uniformly, in strips 5½ yards wide and 5½ yards apart, and in strips 5½ yards wide and 16½ yards apart, respectively. It should always be spread across the direction of migration.

A supplementary measure of great value is the application of oil in irrigation ditches and streams ; its adoption in recent years has prevented the widespread extension of infestation of irrigated crops that results from the fact that the insects readily plunge into water and are sometimes carried for miles in a stream before they crawl out on one of the banks. The best oil to use is a low-grade distillate that forms a good film on water ; it is allowed to drip from barrels set over the stream at intervals of ½–1½ miles, the size of the hole made in the barrel depending on the width and rate of flow of the stream.

WHITE (R. T.). **Effect of Milky Disease on *Tiphia* Parasites of Japanese Beetle Larvae.**—*J. N.Y. ent. Soc.* **51** no. 3 pp. 213–218. Lancaster, Pa., 1943.

Of the several species of *Tiphia* introduced into the United States against *Popillia japonica*, Newm. [*cf. R.A.E.*, A **30** 51, 52], *T. vernalis*, Rohw., and *T. popilliavora*, Rohw., have become well established in the older infested area. The adults of these Scoliids are present in spring and late summer, respectively, and collections are made from thriving colonies for distribution elsewhere. They are not numerous enough to warrant collection in some colonies, however, and experiments were carried out in 1935–37 to ascertain whether this was due to competition with the milky disease caused by *Bacillus popilliae* for the host larvae and to elucidate the inter-relationships of the parasite with the disease when they occur in the same habitat.

Larvae of *P. japonica* that were collected in the field and showed no trace of disease after being kept in sterilised soil for three weeks at 75°F. and healthy laboratory-reared females of *T. vernalis* and *T. popilliavora* were used in the experiments ; the body fluid of diseased larvae was inoculated into the healthy larvae and the parasites were allowed to oviposit in them on the same day or 2–15 days before or after inoculation.

In some of the earlier experiments, *Tiphia* larvae examined immediately after completing their cocoons were found to be infected with milky disease, while those in cocoons examined two weeks later showed no sign of disease. Further observations showed that viable spores of the bacterium were often present in the recently voided meconium in the posterior end of the cocoon and that in such cases there was no evidence of disease in the larva. When larvae of *T. vernalis* that had voided the meconium were examined two months after they had completed their cocoons 52 per cent. of those from hosts that had been exposed to the disease were dead, as compared with 74 per cent. of those from

hosts that had not been so exposed, and the percentages of cocoons that contained infected meconium were 36 and 3, respectively. In one series, 37 per cent. of the host larvae inoculated 2 days after, and all larvae inoculated 10 and 14 days before, oviposition died before the parasite larvae could complete their development. Many of these still had living parasites attached to them. The percentage mortality of larvae of *T. popilliavora* in cocoons examined 30 days after formation was approximately the same (42 and 45 per cent.) whether the hosts had been exposed to disease or not, while the percentages of cocoons containing infected meconium were 40 and 4. Spores of the disease were found in the meconium in cocoons examined after both male and female parasites had emerged from them.

It appears therefore that the parasite larvae are not themselves killed by infection with *B. popilliae*, but die if their hosts are killed by it before they can complete their development. The greatest loss of hosts occurs when the disease is well advanced at the time of oviposition by the parasites. *T. vernalis* oviposits in May, when the soil temperature at Moorestown, New Jersey, does not exceed 65°F., and is therefore not favourable to the rapid growth of the bacterium, and is abundant in areas where the incidence of disease has been consistently high since 1936. *T. popilliavora* oviposits in late August, when the soil temperature is usually above 70°F. and more favourable to disease development, and will therefore probably suffer a greater mortality.

Since it is not likely that either the parasites or the disease will completely eradicate the host, both will persist in varying degrees. A survey in June 1936 of one of several areas in which the parasite was well established and the disease also present showed that 48·4 per cent. of the total host population (larvae, pupae and adults) was parasitised, 38·5 per cent. diseased and 27·6 per cent. healthy ; 14·5 per cent. were thus both parasitised and diseased. It is also possible that the parasites may help to spread the disease, since 22 of 71 adults that had developed in hosts kept in infected soil bore spores on their bodies.

SATTERTHWAIT (A. F.). **Notes on the parasitic Habits of** *Muscina stabulans* **(Fall.) (Diptera, Muscidae).**—*J. N.Y. ent. Soc.* **51** no. 3 pp. 233–234, 1 ref. Lancaster, Pa., 1943.

Following the publication of observations on parasitism by *Muscina stabulans*, Fall., in 1942 [*R.A.E.*, A **31** 367], the author gives records of the emergence of four adults of this fly from a batch of larvae of *Cirphis unipuncta*, Haw., collected in Indiana in 1915 and of two, three and seven from three batches collected in Missouri in 1919. Of sunflower stalks collected in Missouri in July 1927, one contained a pupal cell of *Rhodobaenus tredecimpunctatus*, Ill., in which were four puparia of *M. stabulans* and no foreign matter, so that the weevil was the sole host, and another contained a pupa of *Suleima helianthana*, Ril., parasitised by a larva of this fly. In October 1928, a larva of *M. stabulans* emerged from a larva of *S. helianthana* that had been collected in the main stem of a sunflower in Missouri in September ; the puparium was formed in November and the adult fly emerged in March 1929.

BOHART (R. M.). **New Species of** *Halictophagus* **with a Key to the Genus in North America (Strepsiptera, Halictophagidae).**—*Ann. ent. Soc. Amer.* **36** no. 3 pp. 341–359, 47 figs., 2 refs. Columbus, Ohio, 1943.

An annotated list is given of the species of *Halictophagus*, showing their synonymy, hosts and distribution, together with a key to both sexes of those that occur in America north of Mexico. The new species described include *H. omani*, reared from *Oncometopia* sp. and *O. lateralis*, F., and *H. serratus*, from *Agallia constricta*, Van D., both in the United States ; *H. acutus*, from *Draeculacephala* spp., including *D. mollipes*, Say, and *D. minerva*, Ball, in the United States and *D. minerva* in Mexico ; and *H. indicus*, from *Idiocerus niveosparsus*,

Leth., *I. atkinsoni*, Leth., and *I. clypealis*, Leth., in Mysore. *H. indicus* is the species recorded by T. V. Subramaniam as *Pyrilloxenos compactus*, Pierce [*R.A.E.*, A **10** 219]; the true *H.* (*P.*) *compactus* is a parasite of *Pyrilla aberrans*, Kby., and *P. perpusilla*, Wlk., in India [*cf.* **30** 221, etc.].

Holdaway (F. G.) & others. **Entomological Problems.**—*Rep. Hawaii agric. Exp. Sta. 1941–42* pp. 111–127, 2 figs., 5 refs. Honolulu, 1943.

Owing to war conditions, most of the entomological work in Hawaii in the two years ending 30th June 1942 was concerned with the control of pests of vegetable crops. The most important insects that attack sweet potato in the islands are the Tineid leaf-miner, *Bedellia orchilella*, Wlsm., which sometimes defoliates the plants and kills those that are not well established, the Pyralid, *Omphisa anastomosalis*, Gn., which bores in the stems and sometimes the roots, and *Cylas formicarius*, F., and *Euscepes postfasciatus*, Fairm., which severely damage the tubers and may breed in the stems. Sprays and dusts containing rotenone gave good control of *B. orchilella*, but owing to the shortage of rotenone insecticides a spray of nicotine sulphate and diesel-oil emulsion, which was just as effective, is recommended. The diesel oil is emulsified with bentonite [*R.A.E.*, A **23** 453]. Cryolite, acid lead arsenate, Paris green and calcium arsenate all gave promising results in dips to protect sweet-potato cuttings against *O. anastomosalis*.

In tests of insecticides against various pests of beans, the only one of value for the control of *Adoretus sinicus*, Burm., was acid lead arsenate, which, however, sometimes injures the foliage. Against *Empoasca solana*, DeLong, on green beans, a dust of pyrethrum (2 per cent. pyrethrins) and sulphur (1 : 9) gave about 95 per cent. control and had more residual action than the other treatments tested. Promising initial control was given by sulphur or talc applied as a dust and by a spray containing 5 lb. wettable sulphur per 100 U.S. gals. Cowpeas were best protected against the Jassid by a spray of Bordeaux mixture (3 : 5 : 50), though the highest yields, in decreasing order, were obtained from plants sprayed with Bordeaux mixture and nicotine sulphate (1 : 600), a mixture of 4 lb. pyrethrum powder (2 per cent. pyrethrins) and 10 lb. wettable sulphur per 100 U.S. gals., and Bordeaux mixture alone. A commercial pyrethrum and rotenone spray gave the highest initial mortality, but had little residual effect. In practice, a single application of Bordeaux mixture was highly satisfactory, provided that it was applied when populations were low and the plants growing actively. A Bordeaux spray with the addition of 5 lb. wettable sulphur per 100 U.S. gals. was effective against both *E. solana* and the Capsid, *Pycnoderes quadrimaculatus*, Guér., on bush beans, and the latter was also controlled satisfactorily in experiments by sulphur dusts containing rotenone, and on a larger scale by a dust of lime and 3 per cent. nicotine and a spray of nicotine sulphate (1 : 600) with the addition of 1 pint fish-oil soap per 100 gals. In tests on lima beans to discover an inexpensive substitute for the spray of tetramethyl thiuram disulphide against *Maruca testulalis*, Geyer [*cf.* **29** 650], good results were given by dusts and sprays of cryolite. Dusts containing 60 per cent. calcium arsenate in sulphur or hydrated lime gave some control, but injured the foliage when followed by rain or heavy dew.

Hellula undalis, F., is the most injurious pest of cabbage and, at altitudes of up to 700 ft., where it is present throughout the year, it constitutes one of the most important factors limiting cabbage production. It is seldom of importance at elevations of 1,000–4,000 ft. In tests of various dusts and sprays, the best results were given by a dust containing 1 per cent. rotenone and one of cryolite and talc (1 : 2); a spray of 2 lb. Paris green per 100 U.S. gals. was slightly less satisfactory. Infestation on various cruciferous crops at low elevations in summer was successfully controlled by only two applications of the cryolite dust. The rotenone dust was the best treatment against *Pieris rapae*, L., with

sprays containing rotenone or Paris green next in effectiveness. In further tests against *P. rapae*, complete initial control was given by a dust of rotenone and bentonite, and high initial mortality (84–78 per cent.) by a spray containing 3 lb. Paris green per 100 U.S. gals., a dust of rotenone and talc, and a rotenone spray. A spray of 5 lb. lead arsenate per 100 U.S. gals. had the greatest residual effect and gave 90 per cent. control after 16 days, while one of 4 lb. powder containing 5 per cent. rotenone and ½ U.S. gal. sulphonated castor oil per 100 U.S. gals. gave 78 per cent. control. The leaf tissues were injured by sprays containing sulphonated castor oil where this was retained in depressions.

The chief pests of beets are *Hymenia recurvalis*, F., and the mite, *Tarsonemus* (*Hemitarsonemus*) *latus*, Banks, which also attacks many other vegetable crops. Infestation by *H. recurvalis* may occur at any season at low altitudes, but is most injurious in spring and early summer. Comparative tests were made of various proprietary products containing pyrethrum, which has been shown by other workers to be the most effective material against it [**29** 46], and to determine the most satisfactory method of application. The dusts were diluted to contain 0·2 per cent. pyrethrins and were applied twice at an interval of 14 or 9 days. Several gave satisfactory results, and dusts were in general superior to sprays. When the diluent was sulphur, the mite was also controlled. Pyrethrum dusts also afforded some control of *Empoasca solana* on beets.

Work on the control of *Heliothis armigera*, Hb., which is the most widespread pest of tomatos in Hawaii, was carried out in plots in a field that had already received two applications of an insecticide and in which growing conditions were rendered unfavourable by lack of water. Three applications of a spray containing 6 lb. cryolite, a fungicide and 1 U.S. quart neutral fish-oil soap per 100 U.S. gals. increased the yield by over 45 per cent., and five applications of a dry bait comprising 1 lb. cryolite in 10 lb. maize meal by over 56 per cent. At low elevations, where rainfall is light and infrequent at night, cryolite is effective as a dust or a spray, and also controls *Epitrix parvula*, F., *Laphygma exigua*, Hb., *L. exempta*, Wlk., *Plusia* (*Autographa*) *chalcites*, Esp., and *Keiferia* (*Gnorimoschema*) *lycopersicella*, Busck. Nicotine sulphate can be included in the spray against Aphids.

Infestation of the ears of sweet maize by *H. armigera* is quite frequently as high as 100 per cent. in Hawaii, although the variety extensively grown is tight-husked and injury to individual ears is consequently less severe than in varieties in which the husks are looser. As the control methods in use are unsatisfactory, treatment with mineral oil [*cf.* **31** 274] was tested. A lubricating oil (viscosity 560 secs. Saybolt) with the addition of 1 per cent. dichlorethyl ether injected into the ends of the ears at the rate of 0·8 cc. per ear gave excellent control, but discoloured the ears and imparted an odour to them. The addition of 0·2 per cent. pyrethrins to a refined (medicinal) oil of viscosity 185–195 secs. injected at the same rate caused considerable rotting of the silks, with an associated pungent odour; 2 per cent. dichlorethyl ether added to this oil also caused considerable rotting, but improved control. The addition of 0·075 per cent. rotenone or 1 per cent. dichlorethyl ether was of little value. The refined oil was almost as effective without added insecticides (90 per cent. ears with no or only slight injury) as either oil with them and had no adverse effects; it was less effective at the rate of 0·6 cc. per ear and ineffective at 0·4 cc. Reducing the concentration of pyrethrins and dichlorethyl ether to 0·075 and 1·5 per cent., respectively, rendered them practically ineffective and did not prevent rotting or injury to the silks. Only slight differences in control were shown by three oils with viscosities of 185–195, 145–155 and 100–110 secs., respectively, the lightest being the most effective, and though control was slightly improved by the addition of 0·075, 0·05 and 0·025 per cent. pyrethrins, the percentage of ears contaminated by odour was increased. On the basis of these experiments, the use of a refined mineral oil

with a viscosity of 100–200 secs. at the rate of 0·8 cc. per ear without added insecticides is recommended.

At the beginning of 1941, *Trialeurodes vaporariorum*, Westw., became abundant on green beans in Oahu and in some cases reduced the number of pickings from 10–14 to 1–2 or less per crop. This whitefly has been present in Hawaii for many years, but has not hitherto been of importance. As chemical control has proved ineffective and expensive, an attempt is to be made to introduce the parasite, *Encarsia formosa*, Gah. In the early summer of 1942, the Capsid, *Leucopoecila albofasciata*, Reut., was found to be destroying seedling vegetables, particularly beets and carrots. Insecticides did not prove satisfactory, but seedlings that were protected by means of a light cloth until the appearance of the first leaves produced a crop. Other pests that attracted attention were *Tmolus* (*Thecla*) *echion*, L., which attacked the terminals, blossoms and fruits of egg plant [*Solanum melongena*], *Phyllocoptes destructor*, Keifer, which caused serious injury to tomato on Oahu, *Contarinia sorghicola*, Coq., which damaged sorghum on Oahu and Maui, *Nysius nigriscutellatus*, Usinger, which attacked many vegetables on Oahu, and *Murgantia histrionica*, Hahn (harlequin cabbage bug), which extended its range on Oahu and was recorded on Kauai.

Norris (D. O.) & Hutton (E. M.). **Pea Mosaic with special Reference to its Effect on Yield of Seed.**—*J. Coun. sci. industr. Res. Aust.* **16** no. 3 pp. 149–154, 3 refs. Melbourne, 1943.

As an attempt is being made to produce in Australia all the garden pea seed required there, the effect of the common pea mosaic [*Marmor leguminosarum* of Holmes] on the yield of seed of the most favoured variety, which is very susceptible to the disease, was investigated in 1942. An immune variety was grown for comparison. A third of the seedlings of the susceptible variety were inoculated with the disease on 28th and 29th September, when they had developed four leaves, and another third were sprayed weekly with a solution of 1 pint nicotine sulphate and 4 lb. soft soap in 100 gals. The disease did not spread to any great extent, and the Aphid vectors, *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) and *Myzus persicae*, Sulz , were scarce, the former being the commoner. Naturally infected plants were not observed until 5th November, and the difference in the percentages of natural infection among untreated plants and those sprayed with nicotine, which were 10·11 and 8·64, respectively, was not significant. The percentage of natural infection in rows that were continuous with or adjacent to rows of inoculated plants was 11·5 and 16·5, respectively, but among plants separated by one or more rows from inoculated plants it was only 4·7, indicating that the disease is transmitted chiefly by Aphids crawling from row to row and not by alates. Infection had no significant effect on the yield when the plants were well established, and since the reduction was only 17 per cent. when all the plants were infected at an early stage, the effect of an average field infection, which is lighter, is regarded as negligible.

Pea mosaic is considered unlikely to be of serious importance in Australia, since red clover (*Trifolium pratense*), which serves as a reservoir of the virus and the vectors in New Zealand, is not extensively grown, there are no areas of intensive pea production and Aphid populations are smaller, probably owing to the dry climate, than in New Zealand or America, where pea mosaic is common.

Entomological Investigations.—*16th Rep. Coun. sci. industr. Res. Aust. 1941–42* pp. 14–21. Canberra [1943].

Observations on insect pests of stored wheat in Western Australia in 1941–42 showed that in big bulkhead stores, deep infestations, such as those developing on the floors, died out after a time, presumably because of the high temperatures

reached in the mass of grain, and infestation became and remained localised in the surface layers. Detailed observations on the heating of the wheat indicated that the temperatures reached would prevent insect infestation from penetrating downward for more than 3–4 feet. *Calandra oryzae*, L., was found to be the most important pest in the early stages of storage, but *Rhizopertha dominica*, F., became the dominant species as the temperature increased [*cf. R.A.E.*, A **30** 278]. A study of the temperature changes resulting from the turning of bulk wheat in a concrete silo showed that this treatment will reduce heating only when there is a considerable difference between atmospheric and grain temperatures [**30** 420, etc.]. The results of experiments on the biology of the wheat insects indicated that *R. dominica* is unlikely to breed in grain containing less than 10 per cent. moisture at temperatures of over 100°F.; both *Calandra* and *Rhizopertha* tended to move from drier into moister grain, within the range of moisture contents tested (7–15 per cent.). The preferred temperature of *C. oryzae* was below 77°F., while that of adults of *R. dominica* more than one week old was between 82·5 and 95°F. Sieving cultures of *R. dominica* in grain kept at a temperature just below 80°F. at fortnightly intervals kept the insects under reasonable control, but weekly sieving of cultures kept at a temperature just above 90°F. failed to prevent rapid increases in population, so that this treatment alone is unlikely to be very effective in practice. An account is given of experiments on sterilising the site of the stack, which have already been noticed [**31** 42–44]. Magnesite, used at 4 oz. per bushel, protected bagged grain from *C. oryzae* and *C. granaria*, L., for 12 months in Queensland and New South Wales [*cf.* **31** 45], but treated bags were attacked by *Rhizopertha* in Queensland. Dolomite was effective in Queensland, but not in New South Wales. In fumigation tests, methylallyl chloride was approximately three times as toxic as carbon bisulphide to all three species in 72 hours exposure and had comparable penetration at one-third of the dosage, and it is concluded that 15 lb. carbon bisulphide or 4·5 lb. methylallyl chloride per 1,000 cu. ft., applied at intervals of 5 ft. through the depth of wheat, should give a satisfactory kill in 72 hours in wheat with a temperature of 80°F. or more.

Owing to war conditions, large quantities of wool are being stored in Australia for periods very much longer than usual, and slight damage by *Tineola biselliella*, Humm., and *Tinea pellionella*, L., which are present in almost all the wool stores in Brisbane and in a number of those in Sydney, has been reported from both towns. The larvae attack the baled wool, particularly where the wrapping has been damaged, consume a certain amount and spoil its appearance; from the very widespread character of the infestation, it is probable that many of the bales contained a nucleus of larvae when they entered the stores. Since such damage may become serious, investigations of large-scale methods of control have been begun. Treatment with heat was found to be too expensive, and fumigation with naphthalene or a liquid fumigant is being tested; the latter appears to be the more promising. Flight occurs chiefly ½–2½ hours after sunset, and the females rarely fly; they oviposit on protruding wool and are probably also able to pierce the wrapping with the ovipositor and deposit eggs on the wool beneath. The larvae of *Tineola* tunnel perpendicularly into the wool mass to a depth of ½ in. and pupate under the wrapping or bore through it and pupate on the surface. Moths that emerge from pupae under the wrapping may be able to mate and oviposit without leaving the bale. The larvae of *Tinea* usually occur only in loose wool.

Surveys show that *Chrysomela* (*Chrysolina*) *hyperici*, Forst., introduced for the control of St. John's wort (*Hypericum perforatum*), is spreading in the areas in which it has been liberated, and it was distributed in additional districts in Victoria and particularly in New South Wales [*cf.* **32** 64–65]. Only a few individuals of *Agrilus hyperici*, Crtz., were recovered from *Hypericum* roots in the experimental area in Victoria in which paired adults were isolated on sleeved plants in 1940.

Small incipient swarms of *Chortoicetes terminifera*, Wlk., developed in some parts of the outbreak area of New South Wales in the spring of 1941, but the weather was so dry that further swarming was arrested. In the laboratory newly hatched hoppers kept at 60°F. failed to moult to the second instar, though they took a little food, and died within six weeks. Development was very slow at 70°F., lasting for almost 6 months in some cases, but a small proportion matured; they did not reproduce, however, and soon died. Observations on the interrelationships of locust populations, vegetation and climate were continued [*cf.* **31** 46]; observations on the water and air content of various soil types suggest that only very extreme values of these factors, maintained for relatively long periods, completely prevent hatching. Two methods of modifying the vegetational characteristics of outbreaks centres are being tested. The first involves breaking up the compact soil of oviposition sites by ploughing and replanting the bare areas, and the second, the planting of a barrier of suitable shade trees between the oviposition sites and the concentration zones, to prevent the locusts from moving freely between the two habitats. Another method of preventing swarm formation that is being tested consists in using poison baits to prevent the non-swarming population from increasing to the point at which there is a risk of swarms being formed; this treatment has given at least 30–40 per cent. mortality under the various conditions tested.

In further observations in Western Australia on the effect of infestation by *Halotydeus destructor*, Tucker, on pastures [*cf.* **31** 46], the yield of Wimmera rye grass sown in association with subterranean clover (*Trifolium subterraneum*) varied directly with the yield of the clover, and when this was reduced by mite attack it fell correspondingly, presumably because of a dependence on the increased soil fertility brought about by the clover. Rye grass sown alone had a light yield, and it was not significantly affected by mite attack. The yield of hop clover (*T. procumbens*), which was little injured by the mite, varied inversely with that of *T. subterraneum*. The excellent control of the mite previously obtained with a dinitro-o-cyclohexylphenol dust [*cf.* **31** 47] was not confirmed, possibly owing to different seasonal conditions, and a dust of tobacco leaf grown in Western Australia mixed with slaked lime proved unsuitable without additional active constituents, owing to its low nicotine content; proprietary nicotine dusts and mixtures of nicotine and creosote were the most satisfactory dusts and lauryl thiocyanate and an emulsion of white oil and nicotine sulphate the most satisfactory sprays tested. In sweetened chaff baits [*cf. loc. cit.*], sodium arsenate was more effective than sodium arsenite, sodium fluoride, sodium fluosilicate or tartar emetic, cane sugar was the most suitable sweetening agent and oat or wheat chaff was better than sawdust as a carrier. Only treatment very early in the season protected the pasture effectively. Yields of foliage and seed were heaviest on plots of subterranean clover kept free of mites for the entire year, less heavy on those treated in May, the first month after the appearance of the mites, and consistently low on those treated in the succeeding months, showing that the critical attack occurred at the beginning of the season. Subterranean clover was able to compete quite strongly with capeweed (*Cryptostemma calendulaceum*) in the absence of the mite, but was greatly reduced by mite attack, whereas capeweed was not measurably affected.

Infestation by the cabbage butterfly (*Pieris rapae*, L.) has extended in south-eastern Australia, and consignments of its Braconid parasites, *Apanteles rubecula*, Marsh., and *A. glomeratus*, L., have been received from England and the Dominion Parasite Laboratory at Belleville, Canada, respectively. Small numbers of *A. glomeratus* were released in Canberra. *Alomya debellator*, F., was introduced for the control of *Oncopera* spp.

A detailed survey of the abundance of *Myzus persicae*, Sulz., and *Macrosiphum solanifolii*, Ashm. (*gei*, auct.), which transmit virus diseases of potato, was begun in Canberra and Tasmania in 1941. In Canberra, overwintering eggs of *Myzus persicae* hatched on peach trees in early spring. At about the end of

October, winged individuals migrated to the experimental potato plots, where wingless generations developed. The population reached a peak in late November and then decreased until no Aphids could be found in January and February, when the weather was hot and dry. Later, an autumn generation appeared on potato, and in April, winged Aphids that migrated back to peach were produced. *Macrosiphum solanifolii* bred throughout the winter on a number of foodplants, of which sow-thistle (*Sonchus oleraceus*) was the most important. Winged individuals migrated to the potato plots at about the same time as those of *Myzus persicae*. The population on potatoes reached its maximum in early November and then disappeared. Breeding continued slowly on other foodplants during summer and the population increased to a maximum on these in late autumn. In Tasmania, very few Aphids were present on potatoes in the northern districts, but at Hobart the population was much greater and rose to a very high peak in January, after which it was considerably reduced by large numbers of *Coccinella repanda* var. *transversalis*, F. Infestation of potatoes by *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., was particularly serious in Canberra during the year, and experiments on the control of the moth in the stored tubers are briefly described [*cf.* **31** 325].

Insect Pests.—*Agric. Gaz. N.S.W.* **54** pts. 8–9 pp. 368–372, 422–426, 11 figs. Sydney, 1943.

The first of these two parts of a series on insect pests in New South Wales [*cf. R.A.E.*, A **32** 64] includes a general account of the bionomics of thrips, with the formulae for sprays and dusts recommended against them. The most important species in the State is *Thrips imaginis*, Bagn., which may occur in outbreak numbers in the spring and early summer, when climatic conditions are favourable for its development, particularly after winters in which the rainfall has been above the average. It feeds on the blossoms of fruit trees, vegetables and ornamental plants and may prevent the setting of fruits of apple, pear, peach and plum ; *Citrus* and grape blossoms are also attacked, but fruit setting of these is little affected. The eggs are deposited in all parts of the flowers and neighbouring young leaves, and the immature forms feed usually inside the flowers, but sometimes on young leaves. The prepupal and pupal stages are spent in the soil. The life-cycle varies from ten days to more than a month, depending largely on temperature. *Heliothrips haemorrhoidalis*, Bch., commonly attacks ornamental shrubs and fruit trees, particularly persimmon and to a less extent *Citrus*, out of doors in New South Wales. It feeds principally on the foliage, and all stages are passed on the plants. It prefers shady, cool and fairly moist conditions.

The first part also includes briefer notes on the treatment of boards and the wood of furniture infested by *Anobium punctatum*, Deg. [*cf.* **30** 271], and on the bionomics and control of *Phalaenoides glycine*, Lewin [*cf.* **26** 111]. The larvae of this moth are common pests of grape vines and may seriously damage the young bunches and defoliate the plants ; they also feed on the leaves of fuchsia. The eggs are deposited on the stems and leaves, and the pupal stage is passed in the soil or sometimes between leaves or rubbish cemented together. There are several generations during the summer, and the winter is passed in the pupal stage.

The second part comprises a general account of the life-history of Aphids, with notes on the control and, in some cases, the biology of species that attack fruit trees and vegetables in New South Wales. These comprise *Myzus persicae*, Sulz., and *Anuraphis persicae-niger*, Smith, on peach and nectarine, *Myzus cerasi*, F., on cherry, *Toxoptera aurantii*, Boy., on *Citrus*, *Eriosoma lanigerum*, Hsm., on apple, *M. persicae* and *Brevicoryne brassicae*, L., on cabbage, *Macrosiphum solanifolii*, Ashm., on tomato, *Aphis gossypii*, Glov., on cucurbits, and *Cavariella* sp. on carrot.

Mamet (R.). **The Aphididae of Mauritius. II.**—*Mauritius Inst. Bull.* **2** pt. 3 pp. 171–176. Port Louis, 1943.

Records are given of six additional Aphids from Mauritius [*cf. R.A.E.*, A **28** 396], and of further food-plants, with amended keys.

Hurst (H.). **Principles of insecticidal Bio-assay.**—*Nature* **152** no. 3858 pp. 400–404, 14 refs. London, 1943.

The author points out that attempts hitherto made to correlate chemical and biological tests of insecticides have been based on the invalid assumption that the main function of a carrier medium is to transmit the toxicant to the test insects, after which the concentration of the toxicant is a limiting factor in its effectiveness. He analyses some of the main factors that influence the relations between dosage, referring to the application of a standard quantity of insecticide, and biological activity, measured by some selected specific response shown by the test insect, in systems in which insecticides are brought into contact with insects under controlled conditions. The fundamental variables may be resolved into the test insect, the insecticide and the mode of application, and ways in which variations in these factors affect insecticidal evaluation are illustrated by selected examples in which the insecticides are applied to insects in systems that represent the limits of a range of conditions under which they are generally used in practice. These comprise the complete immersion of the test insect in pure toxicant ; its complete immersion in an insecticidal mixture, when carrier, poison and mixtures of the two are non-toxic to the insect, owing to the impermeability of its cuticle, when both carrier and poison are non-toxic, but mixtures of the two are toxic, in which case relatively enormous changes in the biological activity of an insecticide containing a fixed proportion of toxicant may be produced by variation of the carrier components, and when carrier, poison and mixtures of them are all toxic and the activity of the carrier may obscure that of the toxicant ; the application of the last type of insecticide to the insect by secondary transmission from a residual film primarily deposited on an absorbent substrate, in which the bulk of the insecticide is immobilised in order to eliminate carrier toxicity and the biological responses produced depend on toxicant concentration and film thickness ; and the introduction of poison and carrier into a closed chamber as an atomised spray to control flying insects, in which the individual insect dosage is largely dependent on the relations between insect distribution and spray distribution. In the last case, the factors contributing towards gross toxicity are extremely complex and depend on the activity of the carrier, the vapour pressure of the toxicant, the size of the chamber and the spray storage capacity of its floor.

Cameron (A. E.). **Insect Pests of 1942.**—*Trans. Highl. agric. Soc. Scot.* 1943 repr. 25 pp., 18 figs., 5 refs. Edinburgh, 1943.

This account of injurious insects recorded in Scotland in 1942 includes notes on the bionomics and control of *Psila rosae*, F., which caused widespread damage to carrots, and *Aphis fabae*, Scop., which is an important pest of sugar-beet, though it did not become injurious during the year. Harvested cones of Norway spruce [*Picea abies*] from Scotland and northern England were found to be infested by *Cydia strobilella*, L. This Tortricid, which has also been recorded from pine and fir [*Abies*], has one generation in the year. The moths fly during the day in April and May and lay their eggs on the outside of the cones. The larvae bore into the cones, in which they remain from June until the following April, and then pupate. The pupal stage lasts a week or two. Damaged cones may exude resin and be distorted or stunted or may appear normal; the infestation reduces the quantity and quality of seed produced by

harvested cones, and natural seeding is also affected because many infested cones fall prematurely and do not open completely, so that the seed cannot escape. The most economical and direct method of control would be to collect and destroy immature fallen cones.

THIEM (H.). **Sackträgermotten und ihre Bekämpfung im Rahmen der Winterbehandlung der Obstbäume.** [Case-bearer Moths and their Control in the Course of Winter Treatment of Fruit Trees.]—*Kranke Pflanze* **20** pt. 9–10 pp. 81–88, 2 pls., 3 figs., 8 refs. Dresden, 1943.

Brief notes are given on the bionomics of *Coleophora nigricella*, Steph., *C. anatipennella*, Hb., and *C. hemerobiella*, Scop., which occasionally cause serious injury to fruit trees in central Europe. The first two complete their development in one year, while the last does so in two years. In one large orchard in Germany, 70 per cent. of the buds were infested with from 1 to 10 larvae of *C. nigricella* and 17 per cent. with 4 or more. The moths of all three species fly in June and July. The eggs are laid on the lower surface of the leaves, and in breeding experiments the average numbers per female were 196 for *C. hemerobiella*, 121 for *C. nigricella*, and 78 for *C. anatipennella*. The larvae hatch in about a fortnight and live in cases made of leaves spun together, which are described. Larvae of *C. nigricella* feed on Rosaceae, Betulaceae, Cornaceae and Coniferae, while those of *C. hemerobiella* prefer Rosaceae. Feeding is of slight importance in autumn, but may destroy the buds and leaves in spring and summer. Flowers and fruits are seldom injured. The overwintering larvae of *C. nigricella* have proved difficult to control by means of dormant sprays of tar distillates, which are effective against *C. hemerobiella*, but laboratory and field tests have shown that sprays of 0·4–0·5 per cent. dinitro-ortho-cresol are satisfactory, whether applied in December or March, and also control several other orchard pests.

RICHTER (B.). **Rübenaaskäfer an Spinat.** [Beet Silphids on Spinach.]—*Kranke Pflanze* **20** pt. 9–10 pp. 91–92. Dresden, 1943.

In May 1943, early spinach in a field near Landsberg a.d. Warthe, Germany, was injured by adults and larvae of *Silpha* (*Blitophaga*) *opaca*, L. It is thought that beetles issuing from their winter quarters had been attracted by the young plants. Such damage is likely to recur in years with an early, dry spring like that of 1943.

LANGE (E. G.). **Ein neuartiges Schadbild an Erdbeeren.** [A novel Injury to Strawberry.]—*Kranke Pflanze* **20** pt. 9–10 p. 92. Dresden, 1943.

Injury to strawberries that occurred early in June 1943 in various localities in the Saar district was traced to field mice gnawing the fruits off their stems and to the Carabid beetles, *Carabus auratus*, L., and *Harpalus rufipes*, Deg. (*Ophonus pubescens*, Müll.), eating the seeds. It was considerably reduced by putting down poison baits for the mice and trapping the beetles in pots sunk in the ground.

WILLE (J. E.). **Entomología agrícola del Peru. Manual para entomólogos, ingenieros agrónomos, agricultores y estudiantes de agricultura.** [Agricultural Entomology of Peru. A Manual for Entomologists, agricultural Technicians, Agriculturists and agricultural Students.]—Roy. 8vo, vii+468 pp., 213 figs., 131 refs. Lima, Estac. exp. agríc. La Molina, 1943. Price U.S. $5, post free.

In this comprehensive account of the insects and mites that attack cultivated plants of all kinds in Peru, the information is arranged under crops or groups of

crops and consists of concise surveys of the bionomics and control of the various pests concerned. Cultural, biological, physical and chemical measures of control are summarised in a special section. A glossary of terms used in entomology, general zoology and Peruvian agriculture, and an alphabetical index to the scientific and popular names of the insects and plants and to the insecticides, complete a useful work.

BONDAR (G.). **As cêras no Brasil e o licuri** *Cocos coronata* **Mart. na Bahia.** [Waxes in Brazil and the Licuri Palm, *C. coronata*, in Bahia.]—*Bol. Inst. cent. Fom. econ. Bahia* no. 11, 86 pp., 18 pls., refs. Bahia, 1942. [Recd. 1944.]

This booklet contains a section (pp. 70–75) on insects that infest *Cocos coronata* in Brazil. They cause little if any damage to it, and the only one of economic importance is the Bruchid, *Pachymerus nucleorum*, F., which bores into the kernels, and continues to damage them when they are to be stored [*R.A.E.*, A **27** 661]. The others include *Homalinotus coriaceus*, Gylh., which breeds in the stalks of dead leaves but is a serious pest of coconut. The stored wax is attacked by *Lasioderma serricorne*, F. [*cf.* **30** 425].

BOSQ (J. M.). **Segunda lista de Coleópteros de la República Argentina dañinos a la agricultura.** [A second List of Argentine Coleoptera harmful to Agriculture.]—*Ingen. agron.* **4** nos. 18–22 repr. 80 pp. Buenos Aires, 1942. [Recd. 1944.]

This revised and enlarged list [*cf. R.A.E.*, A **24** 261] includes nearly 700 species, and shows the distribution of each in Argentina, its food-plants and in some cases the type of injury it does. There are indices to the species and to the plants attacked.

PAPERS NOTICED BY TITLE ONLY.

MOUTIA (A.). **The commoner Insect Pests of Orchards, Food Crops, Vegetable and Flower Gardens in Mauritius.**—*Bull. Dep. Agric. Mauritius* Gen. Ser. no. 49, 49 pp. Port Louis, 1943. [Revision: *cf. R.A.E.*, A **24** 448.]

MAMET (R.). **A revised List of the Coccoidea of the Islands of the western Indian Ocean, south of the Equator** [showing food-plants on the various islands and distribution elsewhere].—*Mauritius Inst. Bull.* **2** pt. 3 pp. 137–170, 1 fldg. map, 1 fldg. table, 45 refs. Port Louis, 1943.

MEDLER (J. T.). **The Leafhoppers of Minnesota. Homoptera: Cicadellidae.**—*Tech. Bull. Minn. agric. Exp. Sta.* no. 155, 196 pp., 9 pls., 7½ pp. refs. [St. Paul, Minn.] 1942. [Recd. 1944.]

ALLEN (N.) & POLLARD (H. N.). **Damage to Tobacco by a local Outbreak of** *Heliothis armigera* [in South Carolina] **and some Control Methods employed.**—*J. econ. Ent.* **36** no. 4 pp. 635–636, 1 fig. Menasha, Wis., 1943. [*Cf. R.A.E.*, A **32** 59.]

MCGREGOR (E. A.). **A new Spider Mite** [*Septanychus argentinus*, sp. n., intercepted in New York in pear fruits] **from Argentina.**—*Proc. ent. Soc. Wash.* **45** no. 7 pp. 176–178, 8 figs. Washington, D.C., 1943.

WINTERINGHAM (F. P. W.). **Determination of Fumigants. XI. Determination of Chlorohydrocarbons** [*e.g.*, carbon tetrachloride and ethylene dichloride] **in Air by Reaction in Monoethanolamine. XII. Determination of Ethylene Dichloride and Dichloroethylene. Analysis of Mixtures. XIII. Determination of Chlorohydrocarbons by thermal Decomposition.**—*J. Soc. chem. Ind.* **61** pp. 186–187, 1 fig., 5 refs., pp. 187–190, 1 graph, 3 refs., pp. 190–192, 1 fig., 6 refs. London, 1942. [Recd. 1944.]

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(475) Wt. P12/3742 1,500 5/44 S.E.R. Ltd. Gp. 432.